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JANUARY, 1903
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THE ENGINEERING MAGAZINE

AN INDUSTRIAL REVIEW

EDITED BY JOHN R. DUNLAP
CHARLES B. GOING AND HENRY HARRISON SUPLEE

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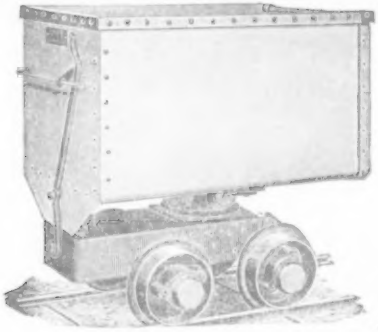

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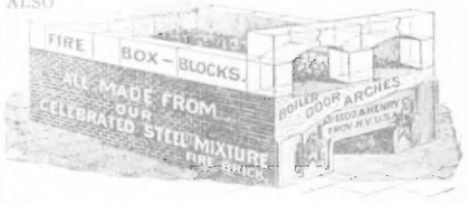

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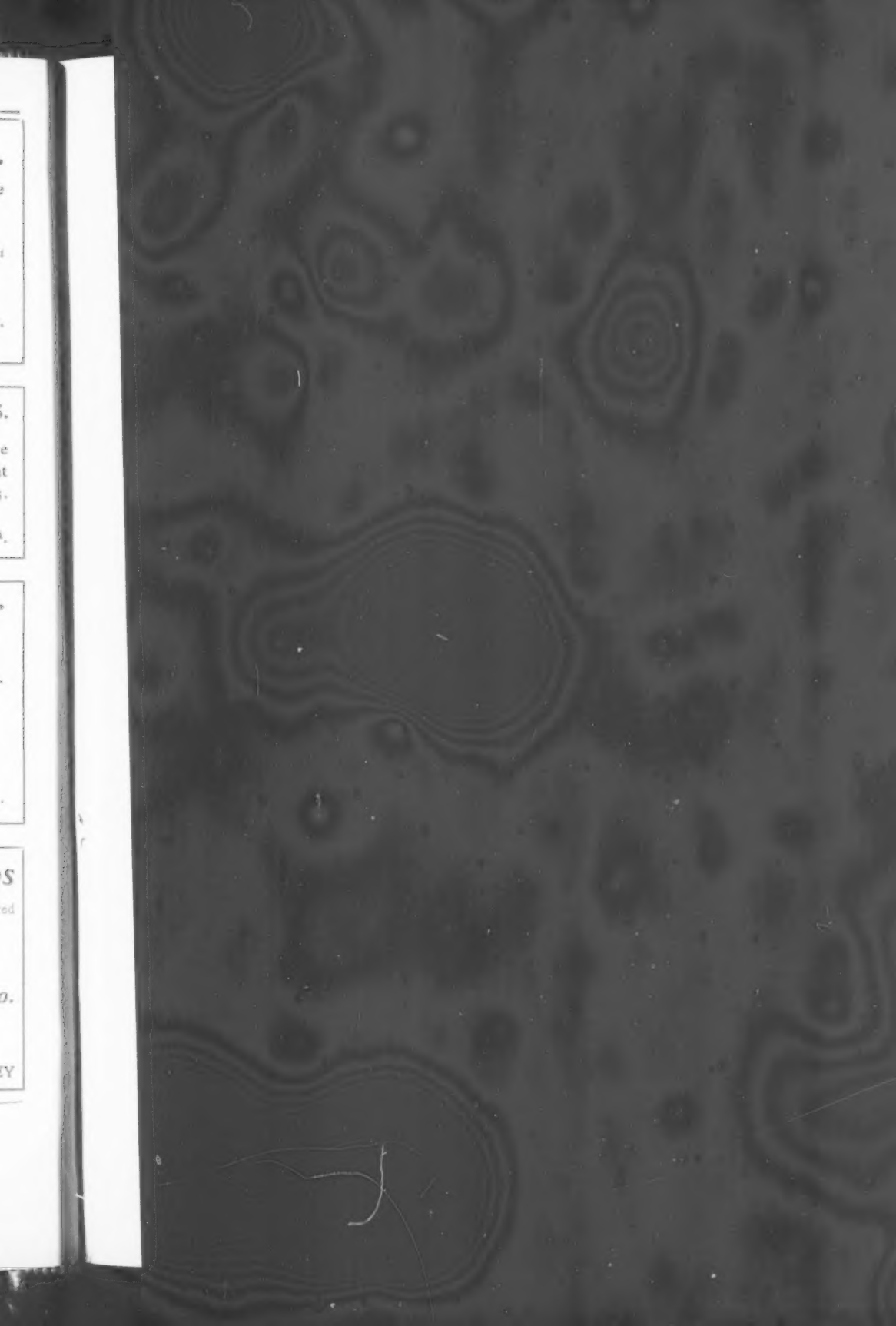

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THE ENGINEERING MAGAZINE
THE WORLD IS ITS FIELD

VOL. XXIV. JANUARY, 1903. No. 4.

LAKE BOHIO
THE SUMMIT LEVEL OF THE PANAMA CANAL.

By George S. Morison. With an Editorial Introduction.

As Member of the Isthmian Canal Commission, Mr. Morison gave particular attention to the Panama Canal route and the several proposed Darien lines. With his pre-eminent rank as an engineer and this intimate familiarity with the special problem under discussion, he is easily a foremost authority upon what might, perhaps, be termed the American plans for the great waterway. His article following is primarily an answer to the argument for the "two-lake" projet of the *Comité Technique*, so earnestly supported by Gen. Abbot in our preceding issue. In effect it is more—it is a brief statement, admirable for its conciseness and sufficiency, of the Isthmian Canal Commission's solution of the two great problems of the work. How different was their position from that of the French engineers in approaching the study—how much greater their freedom to consider the problem as a whole—Mr. Morison explains clearly. In the light of his discussion, one suggestion of our editorial introduction to Gen. Abbot's paper must be withdrawn—that is, that the Commission felt itself too limited as to time for a decision upon working plans. The projet outlined by Mr. Morison is not merely sufficient for comparative estimates, but, in the Commission's opinion, best for the building of the Panama Canal. THE EDITORS.

THE Panama Route was selected more than twenty years ago by the Congress of Paris as the best location for a canal across the American Isthmus. The wisdom of this selection has

throughout its entire range. The feed wheel is connected to the feed screw by a clutch operated by a lever, by moving which it is engaged or disengaged. In the universal saws the clutch also operates the power return movement with which these machines are fitted. A rod attached to this lever engaging with the carriage, operates an automatic stop in both directions. When the clutch is disengaged the carriage can be moved in either direction by hand. The feed nut is solid, 6 inches in length and bushed with bronze. It is bolted and tongued to the carriage, and can be readily moved without dismantling the machine.

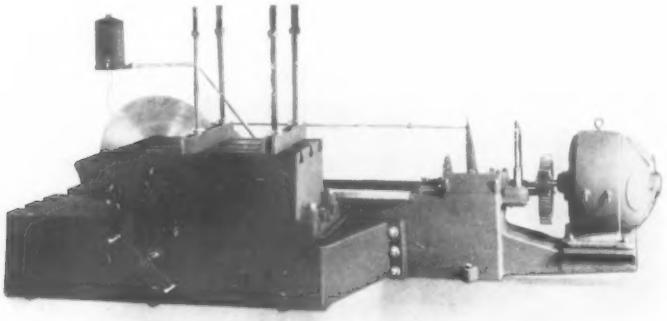
The "Bryant" saw carriage is in two parts, the sprocket shaft bearing being cast in one piece with the worm-gear hood and movable 2½ inches towards the axis of the blade, allowing for a wear of 5 inches in its diameter. The sprocket is removable, and all sprockets on these saws are interchangeable, and readily replaced.

The arbor driven saw carriage is of good design and exceedingly strong and rigid. All bearings are divided at right angles to the direction of the wear and are of extra large proportions. Both arbor gear and pinion are solid with the shaft, the pinion being hardened. The width of the face is large, and the liberal proportions employed have produced a very rigid and quiet-running machine.

All gears in both types of machines are entirely enclosed, avoiding dust and the wear it entails when machines are not advantageously placed. The shears and tables are of strong and rigid design and are provided with oil troughs so that all lubricant is returned to the central trough underneath the saw blade.

The Q & C Co. being the only manufacturers of both these types of machines, are consequently in position to furnish to their customers that type of machine which experience has shown to be best adapted to accomplish the required work with the greatest possible economy.

Further information and catalogue can be obtained from The Q & C Co., Western Union Bldg., Chicago, or 114 Liberty Street, New York.



Q & C METAL-CUTTING MACHINE.

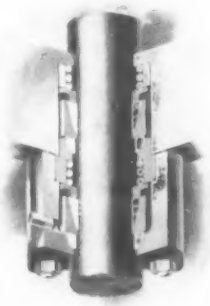
Metallic Packing.

THE United States Metallic Packing Company has long made a specialty of packing valve stems and piston rods on marine and stationary steam engines, and at the present time the type shown in the accompanying illustration, and known as Class 1 Packing, represents the highest stage of development in that line.

This is a double packing, the inner packing composed of one set of babbitt metal rings, which, with their parts, do most of the work. They are separated from the rest of the packing by a dividing piece; then outside of this comes the second set of pack-

ing. Should any water or steam happen to leak through the first set of rings it is caught by the second set and can be drained off; and should the first set of rings wear out or fail while under heavy service, the second set is already on the rod ready to take up the work of the first set at all times.

The great success of this packing is due to its flexibility. No matter how badly an



U. S. METALLIC PACKING.

engine is out of line or how much play there is between cross-heads and guides or between piston and cylinder, the packing floats with the rod, offering very little resistance, so that a hot rod occurring from any fault of the packing itself is practically unknown. This flexibility is due to the combination of the ball joint with the sliding face of the vibrating cup; other types of packing not having this flexibility cause severe wear on rods and packing, accompanied by a great deal of friction.

In order to make a packing thoroughly successful it must be automatically adjusted as wear takes place. With these packings this is done by the steam pressure itself. The springs merely hold the parts of the packings in place when steam is released, and exert only about 10 per cent. of the total pressure on the packing.

All packings are designed to suit the work to which they are to be applied. A packing designed for 250 pounds pressure would not give good results at 50 pounds pressure; so, in order to make a successful packing the conditions under which the packing is to operate must be known.

Any further information on this subject will be gladly furnished by the United States Metallic Packing Company, of 427 North 13th street, Philadelphia.

Fire Hose.

A LARGE proportion of the mills throughout the country are insured in companies which come under the jurisdiction of either the Associated Factory Mutual Insurance Companies or the National Fire Protection Association, and are obliged to have fire hose which fully meets the requirements of these two organizations.

Such a hose is the "American Underwriters" fire hose, which is manufactured by the Boston Belting Company, of Boston, and which is accepted and recommended by the above-named associations. The rubber-lined cotton hose of this kind, which is shown in the accompanying illustration, is adapted for outside use on portable hose reels and on the yard hydrants of factories, and is made in fifty-foot lengths. The unlined linen hose, made from the very best quality of imported Scotch flax, is a reliable safeguard for inside use where it is necessary to hang fire hose up in warm rooms, corridors, stairway towers of textile mills, etc. It is light, compact and convenient, and is furnished in any length desired.

The Boston Belting Company supplies also couplings, playpipes and other accessories to the hose, and has designed a hydrant and hose house, intended for erection

in mill yards, which preserves the hose in good condition and is arranged so as to give easy access to the hydrant.

Any further particulars regarding these matters will be gladly furnished by the Boston Belting Company.

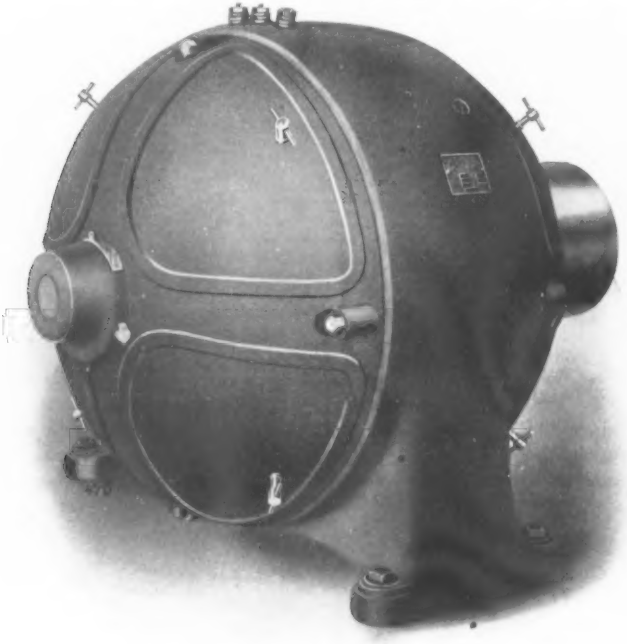
"Ceco" Electrical Machinery.

THE Christensen Engineering Company, Milwaukee, has just placed upon the market complete new lines of "Ceco" electrical machinery, including direct-current motors and generators, alternators and transformers.

For several years this company has been manufacturing electric motors for driving air compressors used in connection with the well known Christensen air brake equipments on electric cars. More than 6500 of these motors are in highly satisfactory service throughout the world. The company has also built a large number of motors of various capacieies for driving air compressors used in general commercial service, and all the motors for driving machine tools and shafting in their own works.

In order to manufacture these motors the company has maintained an extensive equipment, particularly suited to the purpose. Some time ago it was decided to greatly increase the company's manufacturing facilities and to develop a complete line of electrical machinery of the highest grade.

The policy of the Christensen Engineering Co. has always been not to place any apparatus upon the market until the entire work of development has been satisfactorily completed. The exceedingly high reputation and remarkable success of the air brake apparatus are largely due to this policy. Therefore the company has made no announcement regarding its electrical apparatus until the various lines were completely developed and severely tested. The results proved that these machines are in design, construction and performance worthy of the high reputation now accorded to the Christensen air brake equipments.



"CECO" ENCLOSED ELECTRIC MOTOR.

The company is now prepared to build machines up to 1,500 K. W. in capacity, suitable for general power, railway or lighting service.

The line of "Ceco" motors known as

Type C. E., ranging in capacity from 2 to 50 H. P., is illustrated herewith. These motors are made in three styles, open, semi-enclosed and enclosed. The standard styles are belted, but any motor can be geared or direct connected to the driven machine or shaft. The C. E. motors are for general service in industrial establishments of every kind where a high-grade, durable and reliable machine is required.

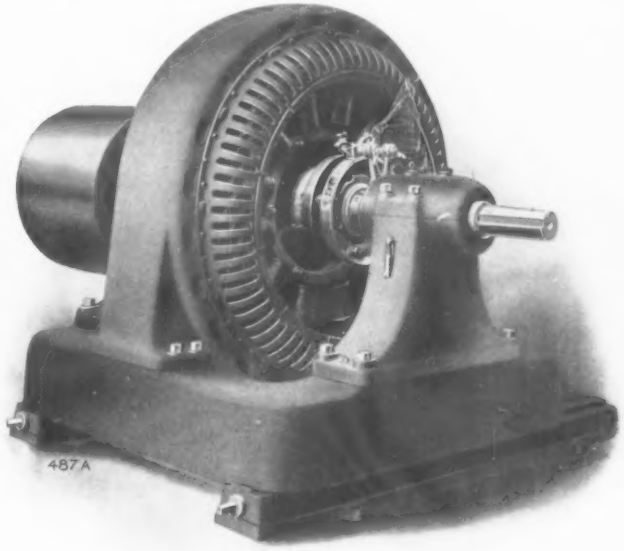
The motors are mounted on a cast iron sub-base which is composed of a single casting, thus insuring perfect alignment. Belt tension is accomplished by moving the motor upon the sub-base in the usual manner.

The ventilation of the armature and commutator is remarkably good, thus insuring a low temperature while running continuously. The "Ceco" motors will operate at their rated loads without the temperature of the armatures rising more than 30° C. The rise in temperature of the field coils under these conditions will not exceed 40°C, and of the commutator 45°C. These machines will operate from no load to full load with the brushes in a fixed position without sparking. They will also operate for two hours with 25 per cent overload, and for two or three minutes with 50 per cent. overload without injurious heating or sparking.

These motors will operate in any position in which the shaft is horizontal. This is accomplished by shifting the bearing brackets on the frame so that the oil chambers remain in the proper position, whether the motor is secured to the floor, the ceiling or the side wall.

A rigid system has been established for the inspection of the parts of each machine while under construction, and there is no poor material or workmanship to hide under canvas, rope, or other "protecting" material. When completed each machine is given a severe running and high insulation test. Then the frame is rubbed with a good filler and painted. All bright parts are polished, so that in addition to being compact in design, substantial in construction and superior in performance, each machine presents a graceful and pleasing appearance.

All the "Ceco" alternators, whether belted, engine type or direct couple, are of the revolving field type, thus leaving the armature stationary, and easily accessible. By



"CECO" POLYPHASE ALTERNATOR.

this form of construction the difficulties of properly insulating the armature coils which have caused much trouble in rotating armatures are eliminated.

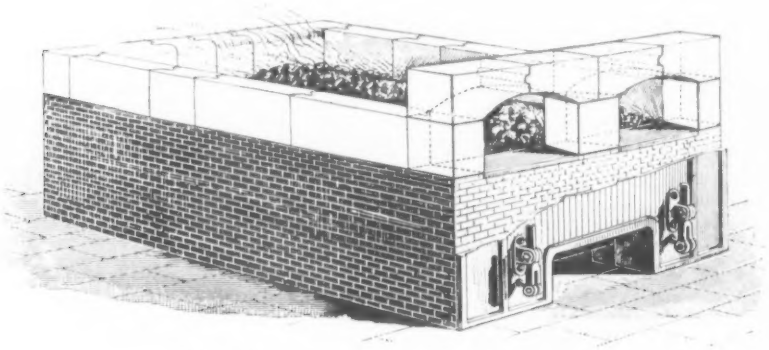
The frame consists of cast iron housings, into which rings of laminated steel with inwardly projecting teeth are assembled, thereby forming slots for receiving the armature windings. The armature is designed with six slots per pole so that it may be wound or rewound for single, 2- or 3-phase as required. The armature frames for the belt-driven alternators are cast in one piece, while the frames for the direct driven machines are divided horizontally. Instead of the usual practice of having several coils for the same machine, all the armature coils for each "Ceco" alternator are of the same size and shape, so that they are interchangeable. The coils are specially insulated, so that they will stand without injury the highest temperature that will ever be reached in service. Standard frequencies are 60 and 25 cycles per second. With the exception of the smaller sizes, "Ceco" alternators can be wound for any voltage up to 15,000.

The Christensen Engineering Company is entering the electrical manufacturing business with exceptional advantages. Its present works were completed but two years ago and no expense was spared in providing every facility for the rapid, accurate and economical manufacture of its product. The equipments of machine tools, cranes, special machines, etc., is unusually extensive, modern and complete. The foundation for a 250-foot extension to the main machine shop, which is 186 feet in width, has just been completed. There are three stories, and this extension will provide 88,000 additional square feet of floor space.

Any further information concerning "Ceco" electrical machinery will be gladly furnished on request by the Christensen Engineering Co.

Steel-Mixture Fire Brick.

IN the construction of fire-boxes and furnaces it is of the greatest importance to have strong and durable, as well as refractory material. These desirable qualities are possessed in a high degree by the "steel mixture" blocks and arches manufactured by the McLeod & Henry Company of Troy, N. Y.



M'LEOD & HENRY STEEL MIXTURE FIRE BLOCKS.

While iron boiler door arches melt at a temperature of 2,200 degrees, the "steel-mixture" arches will not fuse until a temperature of 4,000 degrees is reached.

The fire-box blocks are tongued and grooved, and come in sizes from 12 to 16 inches high and 6 inches thick. When in place, they make a wall the height of the fire all around the fire-box, and this wall is and remains smooth and solid, whereas, when ordinary small fire brick is used, the clay shrinks and leaves space for clinkers.

The "steel-mixture" fire brick has been extensively applied with great success. Any further information concerning it will be cheerfully given by the McLeod & Henry Company.

NEWS SUPPLEMENT

The Engineering Magazine – December, 1902

Coming Society Meetings.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. Sec.: Prof. L. O. Howard, Cosmos Club, Washington, D. C. Annual meeting, Dec. 29 to Jan. 3, Washington.

AMERICAN BOILER MANUFACTURERS' ASSOCIATION. Sec.: J. D. Farasey, Cleveland. Next meeting, July, 1903, at Chattanooga.

AMERICAN ECONOMIC ASSOCIATION. Sec.: F. A. Fetter, Ithaca, N. Y. Annual meeting, Dec. 26-29, Philadelphia.

AMERICAN INSTITUTE OF ARCHITECTS. Sec.: Glen Brown, Washington, D. C. Annual convention Dec. 11, 12 and 13, Washington.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Sec.: Ralph W. Pope, 95 Liberty St., New York. Regular meeting on fourth Friday of each month, 12 W. 31st St., New York. Dec. 19: Paper on Braking and Traction Brakes.

AMERICAN RAILWAY ASSOCIATION. Sec.: W. F. Allen, 24 Park Place, New York. Meeting, April 22, 1903, New York.

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE OF WAY ASSOCIATION. Sec.: L. C. Fritch, Cincinnati. Annual meeting, March, 1903.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION. Sec.: J. W. Taylor. 667 Rookery, Chicago. Meeting, June, 1903.

AMERICAN SOCIETY OF CIVIL ENGINEERS. Sec.: C. W. Hunt, 220 W. 57th St., New York. Regular meetings, first and third Wednesdays of each month. Annual meeting, Jan. 21 and 22, 1903.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Sec.: Prof. F. R. Hutton, 12 W. 31st St., New York. Semi-annual meeting, Dec. 2-5.

BOSTON SOCIETY OF CIVIL ENGINEERS. Sec.: S. E. Tinkham, 715 Tremont Temple. Regular meetings on third Wednesday of each month, except January, when on fourth Wednesday.

CANADIAN RAILWAY CLUB. Sec.: W. H. Rosevear, Jr., Montreal. Regular meetings on second Tuesday of each month.

CANADIAN SOCIETY OF CIVIL ENGINEERS. Sec.: Prof. C. H. McLeod, 877 Dorchester St., Montreal. Regular meetings every alternate Thursday. Annual meeting, Jan. 8, 1903.

CENTRAL RAILWAY CLUB. Sec.: Harry D. Vought, 62 Liberty St., New York. Regular meetings on second Fridays of Nov., Jan., March, May and Sept., Hotel Iroquois, Buffalo.

CHICAGO ELECTRICAL ASSOCIATION. Sec.: W. J. Warder, Jr., 900 Warren Ave. Regular meetings on first Friday of each month.

CIVIL ENGINEERS' CLUB OF CLEVELAND. Sec.: Arthur A. Skeels, 689 The Arcade. Regular meetings on second and fourth Tuesdays of each month.

CIVIL ENGINEERS' SOCIETY OF ST. PAUL. Sec.: G. S. Edmondstone. Regular meetings on second Monday of each month.

ENGINE BUILDERS' ASSOCIATION OF THE UNITED STATES. Sec: D. N. McBrier, Erie, Pa. Annual meeting, Dec. 1 and 2, at Sherry's, 44th St. and 5th Ave., New York.

ENGINEERING ASSOCIATION OF THE SOUTH. Sec.: H. M. Jones, 1000 Broad St., Nashville, Tenn. Regular meetings on second Thursday of each montn, at Vanderbilt University.

ENGINEERS' CLUB OF CHICAGO. Sec.: B. W. Thurtell, 1223 New York Life Building. Regular meetings on first and third Tuesdays of each month.

ENGINEERS' CLUB OF CINCINNATI. Sec.: J. F. Wilson, P. O. Box 333. Regular meetings on third Thursday of each month.

ENGINEERS' CLUB OF COLUMBUS (OHIO). Sec.: H. M. Gates, 12½ North High St. Regular meetings on first and third Saturdays of each month.

ENGINEERS' CLUB OF MINNEAPOLIS. Sec.: Edw. P. Burch, 1210 Guaranty Bldg. Regular meetings on third Monday of each month.

ENGINEERS' CLUB OF PHILADELPHIA. Sec.: L. F. Rondinella, 1122 Girard St. Regular meetings on first and third Saturdays of each month. Twenty-fifth Anniversary banquet, Dec. 6, at the Union League.

ENGINEERS' CLUB OF ST. LOUIS. Sec.: D. W. Roper, 920 Rialto Bldg. Regular meetings on first and third Wednesdays of each month.

ENGINEERS' SOCIETY OF WESTERN NEW YORK. Sec.: George T. Roberts, 975 Ellicott Square, Buffalo. Regular meetings, first Tuesday of each month.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA. Sec.: Chas. W. Ridinger, 410 Penn Ave., Pittsburg. Regular meetings on third Tuesday of each month.

FRANKLIN INSTITUTE. Sec.: Dr. Wm. H. Wahl, 15 South 7th St., Philadelphia. General meetings on third Wednesday of each month. Regular monthly meetings of the various sections on other days.

IOWA RAILROAD CLUB. Sec.: J. A. Wagner, Des Moines, Iowa. Regular meetings on third Tuesday of each month.

LOUISIANA ENGINEERING SOCIETY. Sec.: G. W. Lawes, 712 Union St., New Orleans. Regular meetings on the second Monday of each month.

MASTER CAR BUILDERS' ASSOCIATION. Sec.: J. W. Taylor, 667 Rookery, Chicago. Meeting, June, 1903.

MODERN SCIENCE CLUB. Sec.: R. Henderson, 302 Livingston St., Brooklyn. Meetings every Tuesday.

MONTANA SOCIETY OF ENGINEERS. Sec.: Richard R. Vail, Butte, Mont. Regular meetings on second Saturday in each month.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Sec.: James B. Cahoon, 136 Liberty St., New York. Meeting, May, 1903, Chicago.

NEW ENGLAND RAILROAD CLUB. Sec.: Edw. L. Janes, Back Bay P. O., Boston. Regular meetings second Tuesday in each month at Pierce Hall, Copley Square.

NEW YORK RAILROAD CLUB. Sec.: W. B. Yereance, 418 Center St., South Orange, N. J. Regular meetings on third Friday of each month except June, July and August, at Carnegie Hall, 154 W. 57th St., New York.

NORTH-WEST RAILWAY CLUB. Sec.: T. W. Flannagan, Mineapolis, Minn. Regular meetings on first Tuesday after second Monday of each month, alternating between Minneapolis and St. Paul.

PACIFIC COAST RAILWAY CLUB. Sec.: C. C. Borton, West Oakland, Cal. Regular meetings on third Saturday of each month, at San Francisco.

PACIFIC NORTHWEST SOCIETY OF ENGINEERS. Meetings monthly in Chamber of Commerce rooms, Seattle, Wash.

RAILWAY CLUB OF PITTSBURGH. Sec.: J. D. Conway, P. & L. E. R. R., Pittsburgh, Pa. Regular meetings on fourth Friday of each month at Hotel Henry.

RAILWAY SIGNALING CLUB. Sec.: C. O. Tilton, West Milwaukee, Wis. Regular meetings on second Tuesday of January, March, May, Sept. and Nov.

RICHMOND RAILROAD CLUB. Sec.: F. O. Robinson, 8th & Main Sts., Richmond, Va. Regular meetings on second Thursday of each month.

ROCKY MOUNTAIN RAILWAY CLUB. Sec.: J. E. Buell, 906 20th Ave., Denver. Regular meetings on first Saturday after the 15th of each month.

ST. LOUIS RAILWAY CLUB. Sec.: E. A. Chenery, Union Station, St. Louis. Regular meetings on second Friday of each month.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB. Sec.: W. A. Love, Atlanta, Ga. Regular meetings on third Thursday of Jan., April, Aug. and Nov.

TECHNICAL SOCIETY OF THE PACIFIC COAST. Sec.: Otto von Geldern, 31 Post St., San Francisco. Regular meetings on first Friday of each month.

TEXAS RAILWAY CLUB. Sec.: T. H. Osborne, Pine Bluff, Ark. Regular meetings on third Monday of April and September.

WESTERN RAILWAY CLUB. Sec.: Jos. W. Taylor, 667 Rookery, Chicago. Meetings on third Tuesday of each month, Auditorium Hotel, Chicago.

WESTERN SOCIETY OF ENGINEERS. Sec.: J. H. Warder, Monadnock Block, Chicago. Regular meetings on first Wednesday and extra meetings on third Wednesday of each month. Dec. 3, paper on "Copper Mining in Upper Michigan," by J. F. Jackson; Dec. 17, paper on "Diversity of Engineering Methods on American Railways," by A. A. Schenck.

Personal.

—Dr. Alfred Müller, of 150 Nassau street, New York, has been authorized by the German Society of Engineers to arrange for collaboration in the preparation of the "Technolexikon," or German-English-French technical dictionary which this society has undertaken to publish. Dr. Müller will supply collaborators with specially-arranged note books, and will be glad to furnish further information concerning this highly important and meritorious work.

—Mr. Stephen Pantchenko, of St. Petersburg, who is engineer of ways and communications to the Russian Government, and also director of the J. S. Pantchenko Paper Mills and Coal Mines Company of Rostoff-on-the-Don, is in this country investigating our engineering methods and labor-saving devices. He is specially interested in coal-handling machinery.

—Alfred Mosely, Esq., C. M. G., who is taking a deep and active interest in Britain's commercial and engineering education, has brought a delegation of British trade-union workmen, representing a variety of industries, to America. While in this country, these men will make a thorough investigation of the conditions prevailing here in their respective trades, and they are expected to report the results of their observations to their fellow workmen on their return home.

—Col. Allan C. Bakewell, who was recently elected president of the Sprague Electric Company, has long been identified with the electrical industry, and has won many friends through his executive ability and honorable business methods. He was vice-president and general manager of the old Interior Conduit and Insulation Com-

pany which was absorbed by the Sprague Electric Company some years ago, and has been for three years second vice-president and general manager of the Sprague Company.

—Mr. S. Maximoff, who is engineer to the Russian Government, and assistant at the Imperial Institute of Public Ways in St. Petersburg, has come to America on a tour of observation. While here, he will make a special study of water power and electrical transmission, and will visit some of our principal hydro-electric plants.

—Mr. Chas. G. Eckstein, the German representative of the Philadelphia Pneumatic Tool Co., arrived in New York recently, and will probably remain some weeks in this country.

—Messrs. Kern Dodge and Charles Day of the firm of Dodge & Day, modernizing engineers, have just returned from an extensive trip through the Middle West, where they visited many of the principal machine shops and foundries, gathering data on shop efficiency and critically comparing factory methods.

—Mr. J. W. Duntley, president of the Chicago Pneumatic Tool Company, has again sailed for Europe. He expects to spend about four weeks on the Continent and states that it is his intention to establish, either in England or Scotland, a new plant for the manufacture of pneumatic tools. The design of this new plant will be practically the same as that of the factory now being operated by this company at Detroit, Mich.

—Mr. D. Clarence Durland, who is well known in the electrical field, has been elected second vice-president of the Sprague Electric Company. For the past three years he has been assistant general manager of the Sprague Company and his promotion is evidence of his engineering and executive abilities.

—Mr. N. S. Hill, Jr., has been appointed chief engineer in the Department of Water Supply, Gas and Electricity, New York City, as successor to Mr. G. W. Birdsall, who has been made consulting engineer.

—Mr. William H. Wiley, the well known publisher, and the treasurer of the American Society of Mechanical Engineers, has been elected to Congress from the 8th New Jersey district, on the Republican ticket.

Industrial Notes.

—The business of the Brown Corliss Engine Co., of Corliss, Wis., has increased so rapidly within the last six months that they have found it absolutely necessary to build a foundry. Work on this has been already started, the concrete foundations having been finished, and the steel work on the ground ready for erection. This foundry will be 350 feet long by 116 feet wide, with modern equipment throughout, and will be completed inside of thirty days. The Brown Corliss Engine Co. are about to take up mining machinery, such as hoisting, pumping, compressors, etc., and also rolling mill work, and they purpose to increase their agencies throughout the South and Middle West.

—The city of Elyria, Ohio, has contracted with the New York Continental Jewell Filtration Company, for a filter plant of 2,000,000 gallons capacity per day. The source of the supply is Lake Erie.

—The Quaker Portland Cement Company are about to commence the construction of a cement plant which when completed will be one of the largest in the country. It will be located in the Lehigh Valley cement belt, where five hundred acres of land have been recently purchased. The new company purpose to have a plant constructed upon the latest and most approved plans, and which shall be second to none in the installment of labor saving devices. They will be glad to receive communications from engineers and others familiar with the manufacturing of cement, and they will gladly pay for any suggestions which they may accept. The address of the Quaker Portland Cement Co. is 26 Broadway, New York.

—The Broderick & Bascom Rope Co., of St. Louis, have just issued a very handsomely illustrated and printed treatise on underground wire rope haulage, as successfully applied in the workings of the Coal Valley Mining Company at Sherrard and Cable, Illinois.

—The National Machinery Co., of Tiffin, Ohio, state that the condition of business was never better in their history than it is at present, orders received during the last thirty days being exceptionally heavy. Judging from the amount of orders on hand and the inquiries received, the company do not

anticipate any falling off of the present volume of trade for some time to come. The activity among the railroads has greatly increased the amount of business this fall, and the only difficulty encountered is to make early deliveries, which is greatly impeded by the condition of the raw material market. The company have experienced an exceptional year in the wire-nail machine trade, but find business equally good in all lines,—bolt cutters, headers, bulldozers, spike machines, and their other specialties.

—The crane and hoist demand is in excellent condition as reported by Pawling & Harnischfeger, Milwaukee, Wis. They advise of their recent booking of orders as follows: Baldwin Locomotive Works, Philadelphia, two 10-ton cranes; Manitowoc Steam Boiler Works, Manitowoc, Wis., one 35-ton crane; Consolidated Railways, Light & Power Co., Wilmington, N. C., one 10-ton crane; Pennsylvania Lines West of Pittsburgh, Ft. Wayne, Ind., one 1½-ton hoist; The Lorain Steel Co., Johnstown, Pa., one 7-ton crane; American Sheet Steel Co., Cambridge, O., one 5-ton crane; Berlin Machine Works, Beloit, Wis., one 1½-ton hoist; The Lorain Foundry Co., Lorain, O., one 5-ton crane; Allis-Chalmers Co., Chicago, (for export) one 30-ton crane with 4-ton auxiliary hoist; Colean Implement Co., Peoria, Ill., one 10-ton crane; Allis-Chalmers Co., Fraser & Chalmers Works, Chicago, one 30-ton crane with 8-ton aux. hoist; Gruson Iron Works, Eddystone, Pa., one 20-ton crane; Isaac G. Johnson & Co., Spuyten Duyvil, N. Y., one 3-ton hoist; Allis-Chalmers Co., Chicago, one 5-ton crane.

—An evidence of the sound prosperity of this country is furnished by an "Employers' Bulletin" recently issued by the American Society of Mechanical Engineers for the benefit of its members. In this bulletin there is a long list of positions waiting to be filled, some of them of great promise, and which should apparently be able to meet the desires of the available men in the opposite list.

—American water supply outfits are in high favor in Mexico. The Mexico Commercial Co. is about to install a 20,000-gallon red cypress tank on a 27-foot steel tower at the Chinemaga plantation, Vera Cruz. The Almacences Generales de Deposito de Mexico Y Vera Cruz will have a 10,000-gallon tank on a 51-foot tower in the City of Mexico. Both these outfits have been ordered from the W. E. Caldwell Co. of Louisville, Ky.

—At the Düsseldorf Exhibition which has just terminated, the highest award of merit, the gold medal, was awarded the "Hunt" conveyor. This conveyor is manufactured by the C. W. Hunt Co., West New Brighton, New York.

—The American Blower Company of Detroit, Mich., has recently booked a large number of orders for heating apparatus, including plants for the Lackawanna Steel Co.'s Roll Shop at Buffalo, N. Y.; The Pittsburg Valve Foundry Construction Co., Pittsburg, Pa.; Fox Typewriter Co., Grand Rapids, Mich., and the National Malleable Castings Co., at Sharon, Pa.; as well as the entire drying apparatus for the new starch factory of Piel Bros., Indianapolis, Ind.

—The Philadelphia Pneumatic Tool Co. states that its anticipations in regard to the volume of business for the month of September were fully realized, the sales for that month having amounted to 20 per cent. more than any previous month. During October the monthly record for foreign shipments was again broken, large orders having been received from Great Britain, Germany, France, Italy and Denmark.

—The Pittsburg Filter Mfg. Co., Empire Bldg., Pittsburg, Pa., has had an unusually busy year installing water works filters and water softening plants. Besides having constructed the largest water softening plant in the world, of 2,500,000 gallons, for the Tennessee Coal, Iron & Ry. Co., Birmingham, Ala., they have installed many additional plants in different parts of the United States and in Mexico.

—The Stanley Electric Manufacturing Company has recently opened a sales office in Atlanta, Georgia, to take care of the increasing demand for S. K. C. apparatus in the South. The office is in the Empire Building and is in charge of Mr. George P. Hardy.

—The engineering department of the Pittsburgh Gage & Supply Company, Pittsburgh, Pa., has been unusually rushed with work during the past few days. Recent orders are for one 150-H. P. boiler for the Lincoln Fire Brick Co. plant at Bolivar, Pa.;

one 150-H. P. boiler for the American Porcelain Co., New Brighton, Pa. plant; one 150-H. P. boiler for the Keystone Mining Co. at Leadville, Colo., and one 35-H. P. automatic engine for the Clearfield Steam Laundry Co., Clearfield, Pa.

—There is perhaps no better economy to the steam-fitter and the engineer than a perfectly tight joint, yet one that can be easily taken apart if desired. It is possible to have such joints, if Dixon's graphite pipe-joint compound is used. Flake graphite is impervious to the action of heat or cold, acids or alkalies. Hence the value of a graphite compound when properly prepared. The Joseph Dixon Crucible Company of Jersey City, N. J., will send booklet and sample describing their compound free of charge.

—The Bradley Manufacturing Co., of Pittsburg, have received the contract for a complete electric power station of 500--K. W. capacity, designed for furnishing alternating current, for operating motors for pumping certain oil wells in Wetzel County, West Virginia, belonging to The South Penn Oil Co. C. H. Bradley, Jr. & Co., engineers, of Pittsburg, and who are connected with the Bradley Mfg. Co., have taken the contract for the buildings and equipment, and will install three high-pressure Geary water-tube boilers. The Bradley Manufacturing Co. will furnish two triple expansion condensing Willans central-valve engines, direct connected to alternating-current generators.

—H. B. Underwood & Co., the machinery manufacturers of Philadelphia, are distributing among their friends an ingenious advertising novelty in the shape of a cigar perforator, which makes it unnecessary to cut off the tip of the fragrant weed.

—At the recent Düsseldorf exhibition, Arthur Koppel was awarded the silver medal for his exhibit of industrial railway equipment, dump cars, inclined planes, self-discharging ore cars, electric railroads, etc. This is the highest medal given for industrial railway equipment at this exhibition. It will be remembered that the firm of Arthur Koppel also received the gold and silver medal at the Paris exhibiton, which was the highest award given there for similar material. Arthur Koppel, whose offices are at 66-68 Broad street, New York City, carries a large stock of all standard goods ready for immediate shipment, and will be glad to send catalogues to all interested parties.

—Recent sales of Renold Silent Chain by the Link-Belt Engineering Company include: Nine line shaft drives from motors for the new works of the Patton Paint Company, Newark, N. J.; eight drives from motors to line shafts and elevators in the new model plant which the Crompton & Knowles Loom Works are erecting in Philadelphia; and eight 60-H. P. drives for induced-draft blowers in the new Waterside Station of the New York Edison Company. There are now sixty-one Renold Silent Chains in use in the new building of R. H. Macy & Company, varying in capacity from one to ninety H. P.

—The smoke nuisance is receiving much attention at the hands of the city authorities of Providence, R. I., who are endeavoring to obtain necessary legislation for its abatement. It is a matter of interest that the three largest industrial concerns in the city have voluntarily encouraged this movement by offering to install apparatus in their power stations which would entirely prevent the formation of black smoke. With this purpose in view the Rhode Island & Suburban Railway has contracted for a large equipment of Roney mechanical stokers for its new boiler plant. The plant will have an ultimate boiler capacity of 8,300 H. P. The above stokers will be used throughout. Another large concern, the Narragansett Electric Lighting Co., is also installing a complete equipment of Roney stokers, comprising 12 stokers of the quadruplex type operating under Babcock & Wilcox boilers of 4,500 H. P. capacity. A third industrial plant employing these stokers is the Brown & Sharpe Mfg. Co., where Roney stokers under two batteries of Babcock & Wilcox boilers have been in use for some time with excellent results. The success of this installation undoubtedly furnished the incentive toward the smoke prevention movement.

—The Derry-Collard Co., of 256 Broadway, New York, have come out with an attractive proposition for those who buy books. They will send any technical book, published anywhere by anyone, which costs one dollar or more, on approval for two or

three days, and after examining it as thoroughly as he wishes, the prospective buyer can pay the price or return the book. The Derry-Collard Co. also stand ready to advise on anything in the way of educational books and methods.

—According to the "Sheffield (Eng.) Daily Telegraph," it is the annual custom for the head of the Cutlers' Company of that city to invite his guests, on the day after the Cutlers' Feast, to visit some of the representative works of the place. This year the Master Cutler, Mr. A. J. Hobson, who is not only the senior partner in the firm of Thomas Turner & Co., where the staple trades of cutlery, saw, and file making are extensively carried on, but is also a director of the great concern of William Jessop & Sons, (Limited), whose steel is famous all the world over, arranged for tours of both of these establishments. A special train conveyed the party to Brightside, and Jessop's works were soon reached. Luncheon was provided in a marquee specially erected, and afterwards a couple of hours were devoted to a tour of the vast establishment, which occupies 40 acres of ground, and employs some 1,500 or 1,600 workpeople. The specialties of this ancient firm, which dates from 1774, are crucible steel of the highest class for use as mining and engineering tools, and Siemens' steel for large castings. The guests had seen crucible steel made in the morning, but they were now to see it on a scale which is not exceeded, if, indeed, it is equalled, in the world. Messrs. Jessop turn out some 10,000 tons of this material every year, and their furnaces and crucibles are legion. They have recently established a works at Washington, Pennsylvania, where they will manufacture the specialties which have made their home plant so justly famous.

—The annual meeting of the stockholders of the Sprague Electric Company was held Tuesday, October 14th, 1902, at the office of the Company in Watsessing, N. J. The following directors were elected for the ensuing year: Messrs. Allan C. Blakewell, D. C. Durland, S. M. Hamill, J. R. Lovejoy, John Markle, J. R. McKee and E. G. Waters. At a meeting of the directors held later in the day, officers were elected as follows: President, Allan C. Bakewell; 1st Vice-President, S. M. Hamill; 2nd Vice-President, D. C. Durland; Secretary and Treasurer, Harry R. Swartz.

—The Otis Elevator Company has recently received the contract for the elevator and dumb-waiter equipment of the new Astor Hotel, Long Acre Square, 44th to 45th streets, New York. The plant consists of seven electric passenger elevators, two electric servants' elevators, eleven electric dumb-waiters, and three electric side-walk lifts.

—The Loder Railroad Protective System, of 271 Broadway, New York, has been founded by Mr. Cornelius S. Loder for the purpose of providing railroads with a service whereby they may get confidential information about prospective and discharged employees, fraudulent accident suits, railroad equipment and supply houses, improved operating systems, and various other matters. The Loder System will also have a legal department which will act for the railroad companies in any desired cases.

—The Lunkenheimer Company, of Cincinnati, Ohio, manufacturers of brass and iron goods and specialties for engines, boilers, etc., such as brass and iron valves, whistles, injectors, lubricators, oil and grease cups, etc., on Saturday, October 25, formally opened their new works to about three thousand visitors and friends and are now moving from their old quarters. The new buildings, of which there are five, represent an investment of over three hundred thousand dollars, and consist of the main building, occupied by the brass department, with adjoining buildings for the iron department, brass foundry, power building and office building; all are of pressed brick and steel construction of modern type. They occupy about three acres of ground and have switching facilities; three acres additional ground provide for the future extension of the business. These factories are located near Brighton Station in a section of the city called Fairmount, within two miles of the center of the city. It has been the aim of the company to construct the "model" plant in this industry and many new and interesting features are noticeable.

—The Lazier Gas Engine Co., of Buffalo, have just been awarded the gold medal of merit for the excellence of their engines, at the Amsterdam, Holland, Exposition.

NEW CATALOGUES AND TRADE PUBLICATIONS

These catalogues may be had free of charge on application to the firms issuing them. Please mention The Engineering Magazine when you write.

Air Brakes.

Catalogue No. 53, with descriptions and complete illustrations, in the text and on plates, of straight air-brake equipments, with independent motor compressor, for electric railway cars. 9¼ by 6 in.; pp. 57. Also, publication No. 54, with illustrated account of where these air brakes are made and where used. Also, catalogue No. 55, devoted to "Ceco" electrical machinery. Christensen Engineering Co., Milwaukee, Wis.

Air Compressors.

Catalogue I-2, with illustrations and descriptions of the "Imperial" air compressors, which are highly automatic in their action, and which are shown in various styles and sizes, driven by steam engines as well as by electric motors. 9 by 6 in.; pp. 31. Rand Drill Co., 128 Broadway, New York.

Automobiles.

Catalogue, with illustrated descriptions of the different styles of the "Locomobile" steam vehicle and its details, and illustrations and accounts of the performance of these vehicles all over the world. 9½ by 6 in.; pp. 31. Also, pamphlet with illustrated account of the ascent of Pike's Peak in a "Locomobile"; and booklet with account of experiences with a "Locomobile" in the South African war. The Locomobile Co. of America, New York.

Blue-Print Machine.

Pamphlet with descriptions, illustrations and price list of cylindrical blue-printing frames and arc lamps for copying by electric light, and of blue-print wringers. 9 by 6 in.; pp. 14. The Pittsburg Blue Print Co., Pittsburg, Pa.

Brick Machinery.

Catalogue No. 60, containing descriptions and illustrations of soft mud, wire cut and dry press brick machinery and brick yard supplies, with steam or animal power equipments complete. 9¼ by 6 in.; pp. 108. The Henry Martin Brick Machine Mfg. Co., Inc., Lancaster, Pa.

Card Index.

Catalogue No. 104, illustrating and describing the Rockwell-Wabash card file systems, with various styles of cards and cabinets for all kinds of index and record purposes. 10 by 6¾ in.; pp. 38. Rockwell & Rupel Co., Chicago.

Corrugating.

Catalogue No. 180, with illustrated descriptions of corrugated and plain tin plates, black sheets, galvanized sheets, eaves troughs, conductor pipes, steel roofings, tin roofings and steel lath, and decorative steel ceilings. 10 by 8 in.; pp. 76. Also, large catalogue with illustrations and prices of embossed steel ceilings and wall plates in many styles and designs. 12 by 9½ in.; pp. 124. Wheeling Corrugating Co., Wheeling, West Va.

Coverings.

Descriptive catalogue of Carey's coverings, including magnesia and asbestos steam-pipe and boiler coverings, air-chamber covering for refrigerating plants, magnesia flexible cement roofing and many other kinds. 6½ by 4¾ in.; pp. 40. Also, booklets devoted to different kinds of coverings. The Philip Carey Mfg. Co., Lockland, Ohio.

Customs Regulations.

Booklet entitled "What One May Bring Out of Mexico Without Paying Duty," in which the United States tariff laws and customs regulations concerning travelers' baggage and personal effects are interpreted by the U. S. Secretary of the Treasury. 6 by 3½ in.; pp. 18. Southern Pacific Railway Co., 349 Broadway, New York.

Drafting Machine.

Pamphlet with illustrated description of the "Universal" drafting machine, which consists of a graduated square having an accurate parallel motion about the drawing board, this parallel motion being obtained by means of two pivoted parallelograms joining the square to the board. 6 by 9 in.; pp. 15. Universal Drafting Machine Co., Cleveland, Ohio.

Electric Traction.

Large, cloth-bound book, describing the manufacture of large continuous-current generators, illustrated with photogravures of the machines and of some power houses where they are installed. 10 by 14 in.; pp. 37. Also, large, illustrated pamphlets devoted, respectively, to the works of the English Electric Manufacturing Co., Ltd., at Preston, Lancashire; rolling stock for electric traction, as manufactured by the Electric Railway and Tramway Carriage Co., Ltd., Preston; results of high acceleration with electric traction on railways; and the Camps Bay, Cape Town and Sea Point Tramways, at the Cape of Good Hope. Dick, Kerr & Co., Ltd., London.

Fans and Blowers.

Bulletin No. 3020, with illustrated descriptions of ventilating fans for removing heat, dust, moisture, steam and impure air, and of steel-plate blowers of highest quality for pressure work and hot and cold air ventilating systems, direct driven by electric motors. 10½ by 7¾ in.; pp. 18. Western Electric Co., Chicago.

Feed-Water Heaters.

Pamphlet, with tastefully designed cover, containing a concise but comprehensive essay on the heating of boiler feed-water. Special attention is devoted to exhaust-steam heaters, and there are heat-absorption curves from actual tests showing the advantage of corrugated tubes over plain tubes. 6½ by 5 in.; pp. 14. Charles H. Paine, Singer Bldg., Broadway and Liberty St., New York.

Flour-Milling Machinery.

Catalogue with descriptions and many illustrations of flour-milling appliances of all kinds, including roller machines, force feeders, corn and cob crushers, gyrators, aspirators, purifiers, screens, separators, mixers, packers, etc. 9½ by 6½ in.; pp. 96. Also, pocket price list of flouring mill, elevating, conveying and power-transmitting machinery and turbine water wheels. The Wolf Co., Chambersburg, Pa.

Gear Shaper.

Book bound in heavy card covers, with many half-tone and line-cut illustrations, describing the Fellows gear shaper for cutting gear teeth and its action, with directions for setting it up and operating it. 9 by 6 in.; pp. 33. The Fellows Gear Shaper Co., Springfield, Vermont.

Graphite.

Catalogue, with general description and illustrations of graphite productions, including crucibles, lubricants, paint, electrical supplies, pencils, stove polish, etc. 9 by 6 in.; pp. 77. Joseph Dixon Crucible Co., Jersey City, N. J.

Machinery.

Catalogue A, in full leather binding, with illustrated descriptions of bolt and nut machinery, upsetting, forging and bending machinery, spike, rivet, wire nail and special machinery. Also, useful tables and data. 8 by 10½ in.; pp. 233, with interleaves ruled in squares for notes. The National Machinery Co., Tiffin, Ohio.

Machine Tools.

Bulletins with illustrated descriptions of the most up-to-date vertical boring and turning mills; planers; wall radial drilling machines; automatic grinding machines for connecting links; combined shaping and side-planing machine, with two tables; slotting machines; two-spindled centering machines; steam hammers; and pneumatic tools. 7¼ by 10¾ in. de Fries & Cie, Düsseldorf.

Mechanical Cashier.

A pamphlet with illustrated description of the mechanical cashier, a machine which receives money, places it beyond the reach of the operator, records the transaction and the number of the operator who makes it, stamps the cash check with the amount, totalizes, and makes change. 8¼ by 6¼ in.; pp. 21. This pamphlet is very tastefully and artistically written, arranged and printed under the direction of Ray D. Lillibridge. American Mechanical Cashier Co., 40 Wall St., New York.

Mill Machinery.

General Catalogue No. 7, with illustrations, descriptions and prices of elevating, conveying and general mill machinery of all kinds, with details and accessories, and useful tables and data. 9 by 6 in.; pp. 288. The C. O. Bartlett and Snow Co., Cleveland, Ohio.

Mining Drills.

Catalogue, with illustrations and descriptions of hand mining drills of every variety, and some styles of air drills, and views showing the drills in operation. 9½ by 6¼ in.; pp. 50. Howells Mining Drill Co., Plymouth, Pa.

Mining Machinery.

Catalogue for 1902, sections 1 and 2, devoted respectively to gold and silver milling machinery and to boilers and sheet metal work, including tanks, buckets, ore cars, smoke stacks and pipe, with fully-illustrated descriptions. 9¼ by 7 in. Also, pamphlets devoted respectively to the McCully rock and ore crusher and Holthoff "straight-line" crushing rolls. The Holthoff Machinery Co., Cudahy, Wis.

Nernst Lamp.

Booklet on "The Distribution of Light from the Nernst Lamp," showing how illumination, as distinct from intensity of light, depends upon the distribution and the quality of light, and indicating the proper way to secure the best illumination. Nernst Lamp Co., Pittsburg, Pa.

Pumping Machinery.

Catalogue with illustrations, descriptions and price list of deep-well pumping machinery and tube-well supplies, useful information and telegraph code. 6 by 9 in.; pp. 76. Also, general catalogue No. 24, illustrating steam and power pumping machinery of the single cylinder, duplex, crank and fly-wheel types, and booklets devoted to pumping machinery and to steam-plant apparatus. The John H. McGowan Co., Cincinnati, Ohio.

Punches and Shears.

Catalogues A, B and D, with descriptions, illustrations and price lists of hand- and belt-power punching and shearing machinery, in all sizes and for all kinds of work. 9 by 6 in. New Doty Manufacturing Co., Janesville, Wis.

Trucks.

"Record of Recent Construction," No. 38, with illustrations and descriptions of trucks for electric-motor cars and trailers, particularly those for heavy and high-speed service. 6 by 9 in.; pp. 36. Baldwin Locomotive Works, Philadelphia.

Water Wheels.

Catalogue (ninth edition), completely illustrated, describing the Pelton water wheel, particularly adapted to high heads, and the Pelton system of water power, with accounts of some of the Pelton plants, directions for the measurement of water, and useful tables and data. 9 by 6 in.; pp. 88. The Pelton Water Wheel Co., San Francisco, Cal.

Well Machinery.

Comprehensive catalogue, with illustrations, descriptions and price lists of well-sinking, prospecting, pumping and irrigating machinery, air compressors, Chapman's air water lift, gasoline and steam engines, boilers, etc., and accounts and views of various applications. 9 by 6 in.; pp. 160. The American Well Works, Aurora, Illinois. British-American Well Works, London.

Wood-Working Machinery.

Catalogue with illustrated descriptions of all kinds of wood-working machinery, telegraph code and index. 6½ by 4½ in.; pp. 284. This catalogue gives plain, straight-forward accounts of the machines actually constructed at the present time at the several factories of the American Wood-Working Machinery Co., New York.

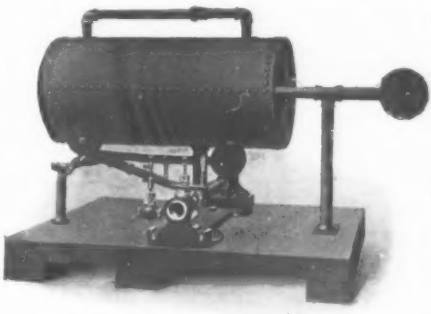
IMPROVED MACHINERY

New Processes and New Appliances

The matter here published is not paid for, nor can it be classed as advertising. But as the information is necessarily obtained from those who offer the appliances for sale, it is proper to say that the manufacturers, rather than ourselves, are responsible for the statements made.

The Morehead Return Trap.

THE condensation from any steam heating or cooking apparatus must be removed. The more quickly the condensation is removed the drier and more effective will be the heating surfaces. It is the greatest extravagance to waste it, as it is pure water, and hot. The most effective way to utilize the heat it contains is to deliver it into the boiler before it vaporizes, and in no other manner can the condensation be handled as quickly and with the same economy as with a return trap.



MOREHEAD RETURN TRAP.

The Morehead return trap is constructed of steel, the heads and longitudinal seams being closely riveted and calked, to withstand any pressure carried on the boiler without breaking, which is impossible with cast-iron traps. It is the embodiment of simplicity, there being no rubber joints to blow out or leak, and only one valve, which is on the outside. All working parts are on the outside, in plain sight, and easily accessible. There is no ball or globe float inside the receiver to collapse, leak, rust or stick.

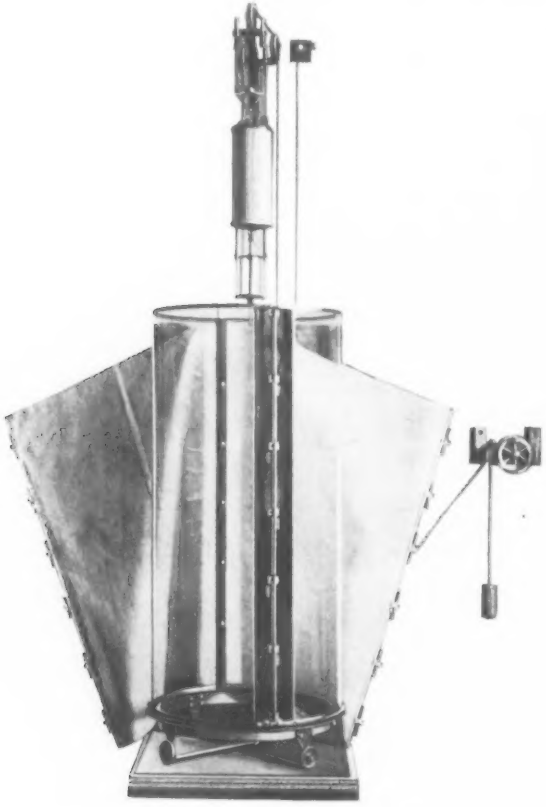
This trap is located six feet or more above the water-line of boiler. The water from the condensing surfaces is forced by the pressure of steam from behind, through a pipe leading to the trap with a swing check valve close to the latter. As soon as sufficient water has entered the receiver to overcome the weight on the arm, the receiver tilts down, allowing the water to pass through the discharge pipe, at the same time opening the steam valve, which has a pipe connected with the dome of the boiler.

By equalizing the pressure on the surface of the water in the receiver with that in the boiler, the water, in simple obedience to the laws of gravity, flows into the boiler. As soon as the receiver is empty it tilts back as before, and again refills. The trap is prompt in opening and closing, its action being due entirely to gravity. When once set up it requires no further attention. It takes the water from the condensing surfaces whether they are above or below the water level in the boiler, and automatically returns it to the boiler at the temperature due to the pressure at which the steam is condensed. There is no outlet by which the steam can be wasted. The trap is quick and positive in delivering the water into the boiler against any pressure, and regardless of fluctuations of pressure. It supplies all the water needed in the boiler from the main water pipe, providing there is enough pressure on the main to lift the water to the trap, thus performing the duties of a pump or injector. It operates equally well with high- or low-pressure coils, or coils using exhaust steam, allowing no condensation to collect in them.

For a boiler plant of 200 H. P. having an efficiency of 65 per cent. and an evaporation of 6,900 pounds of water per hour, from and at 212 degrees, under average conditions,

the saving affected by a Morehead return trap for a year is more than twice the cost of installing one large enough to handle such a plant.

Where a Morehead return trap is not employed, the usual way of handling condensation is by means of a pump. A comparison of the two methods shows many points of advantage in favor of the former. A pump will not lift water at a temperature exceeding 212 degrees; a Morehead return trap will. A pump consumes an extravagant amount of steam to do a very little work. For example, an ordinary duplex boiler-feed pump requires from 90 to 120 pounds of steam per horse power hour. A common slide valve engine seldom consumes less than 40 pounds per horse power. The Morehead return trap consumes less than 10 pounds per horse power. The pressure is admitted to the surface of the water, and is automatically shut off before the tank is empty. The steam used is only such as is condensed by the latent heat passing from it into the water in the tank, which is all put back into the boiler.



PITTSBURG BLUE-PRINTING MACHINE.

A Morehead return trap requires practically no attention; needs no lubrication; will not race or run away; is noiseless; requires little room and no foundation.

Full information, prices, etc., of the Morehead return trap may be obtained by addressing the American Blower Co., of Detroit, Mich., or any of their branch offices

Blue-Printing Machine.

IT is safe to assert that there is not an engineer or architect who has not often been greatly inconvenienced by the impossibility of getting good blue prints of important drawings at the time required. It is not unusual to hear of cases where important work has been stopped until a spell of cloudy weather had passed and the blue-printing department were able to make the blue prints necessary before continuing the work. Recognizing the urgent need for some reliable and efficient means of making the blue-printing department absolutely independent of weather conditions, the Pittsburg Blue Print Company introduced their patent cylindrical electric copier, and have already installed over one hundred of them in the offices of some of the largest and most conservative concerns in this country.

The Standard Upright Machine is shown in the illustration and is the best type for almost all work. It consists of two glass half cylinders bent to practically true curves bound together with brass bands top and bottom, and having wooden strips between the edges of the glasses. A strong canvas cover fits around the glass to hold the tracings and paper in place and insures good contact. This cylinder rests on a base which is mounted on wheels and revolves about the axis of the cylinder. An arc lamp of special design and construction is suspended by chains which pass over the sheave wheels on the bracket and are attached to a counterweight at the back of the machine, the lamp being heavier than the counterweight. Another chain connects the counterweight with the drum of the "auto-gear" or escapement mechanism for regulating the speed of the lamp in its descent.

In operation the tracing and sensitized paper are placed between the glass and canvas cover, and the lamp passing axially through the cylinder gives uniform exposure to all parts of the print.

The Tilting type is especially adapted for making copies of very small tracings where a large number are to be placed in the machine at each loading. The glass half cylinders are held between cast-iron end rings grooved to receive the ends of each half. These end rings are held together and the cylinder construction made rigid by the side channels, to which are attached the trunnions. The frame is made up of wrought-iron pipe and angles, with the necessary cast and wrought iron fittings, braces being attached to render the whole machine absolutely rigid when erected.

In operation the cylinder is revolved to the horizontal position and the tracings and sensitized paper put between the top glass and canvas. The cylinder is then turned through 180° and the other side filled up with tracings and paper. The cylinder is now turned to the upright position and the printing done in the same way as in the upright machine.

In addition to the greater convenience and reliability of the electric copier as compared with the sun process, the prints can also be made much cheaper by this copier, as is shown by figures based on the actual experience of users of the machines.

Any further information desired will be cheerfully given by the manufacturers, the Pittsburg Blue Print Co., of Pittsburg.

Universal Radial Drill.

A new universal radial drill, possessing a number of novel features, has recently been placed upon the market by the Bickford Drill & Tool Co., of Cincinnati.

In this machine, cone pulleys for obtaining different speeds have been replaced by plain pulleys and a nest of gears with clutches and levers for throwing the different combinations into action. Aside from the quickness with which the speed changes can thus be made, there is the advantage of having the belt run at full speed when drilling in heavy work—thereby eliminating the defect often found in cone pulleys of having the speed slow down. This arrangement is especially convenient when constant speed motors are used.

In addition to a corresponding nest of gears with suitable levers and clutches in the feeding mechanism, other features of the machine are: A gauge for reading all depths from zero, a multiple automatic trip which operates at one setting, at as many different depths as there are holes to be drilled, an absolute safety stop and a tapping device that operates at all speeds.

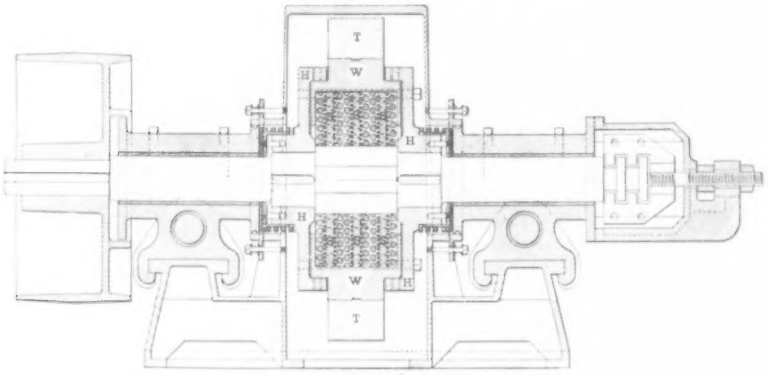
The tripping mechanism operates at as many as 12 different depths at one setting of the work. The depth gauge is also pro-

these press back the tire spring weights; then the tire is released, and may be slipped off easily. When tires are replaced the set screws are taken out, and the tires at once secure themselves.

The manufacturers argue briefly the questions of large and small roll constructions in the following interesting manner: Since rolls crush by the pressures of their revolving tire surfaces, it is plain that if the tire widths and pressures are the same the output of all rolls will be in exact proportion to tire velocities, regardless of diameters. A small roll, therefore, may do as much as a large one, if the tires can attain the same speed.

repairs are expensive, and their big tires are not taken off or replaced easily. Centrifugal rolls on finishing work run with nearly the quietness of dynamos. They can easily surpass, in any size, common roll velocities; and just here is met a consideration of great practical importance.

In roll crushing, there is found for each ore, a tire speed that gives the largest output per pound of tire wear. This can only be determined by experience. In most cases this economical speed is found to be far above the turning ability of common rolls. Any centrifugal roll can run to that speed, and no other rolls can.



PATENTED

CENTRIFUGAL CRUSHING ROLLS.

That they can do this in centrifugal rolls is beyond doubt, for they run easily at almost any speeds, high or low; and the tire surfaces of the smallest centrifugal rolls can equal the travel of the largest roll tires that can be constructed, and do as much work for the same width of tire.

What, then, is the advantage of the large, expensive common roll? The large common roll has greater grasp, and can seize and break large rock. It is a coarse crusher; the small centrifugal roll, on the other hand, is a finisher.

But the large rolls pay dearly for this single point of advantage, and the work they do can be much more cheaply done in a roll jaw fine crusher. Large rolls cost more to buy, to transport, and to run. The shocks of crushing on their heavy backward and forward moving parts are destructive;

The wear of a small tire surface, even when running at the tire speeds of the largest rolls, is no greater than that of a large tire having the same velocity. In both cases the same amount of metal is exposed to wear in the same time. The smallest rolls, however, must not be used as coarse crushers; although in everything else they are superior.

Large centrifugal rolls can run even on large rock at much higher speeds than common rolls, and are well suited to either coarse or finishing work. In most cases centrifugals do three times as much as common rolls of equal size.

In a handsome circular of crushing and grinding machinery, which the Sturtevant Mill Company, of Boston, Mass., issue frequently, and gladly send to inquirers, this matter is further considered.

NEWS SUPPLEMENT

The Engineering Magazine—January, 1903

Coming Society Meetings.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. Sec.: Prof. L. O. Howard, Cosmos Club, Washington, D. C. Annual meeting, Dec. 29 to Jan. 3, Washington.

AMERICAN BOILER MANUFACTURERS' ASSOCIATION. Sec.: J. D. Farasey, Cleveland. Next meeting, July, 1903, at Chattanooga.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS Sec.: Ralph W. Pope, 95 Liberty St., New York. Regular meeting on fourth Friday of each month, 12 W. 31st St., New York. Jan. 23: Paper on "Telephone Exchanges."

AMERICAN RAILWAY ASSOCIATION. Sec.: W. F. Allen, 24 Park Place, New York. Meeting, April 22, 1903, New York.

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE OF WAY ASSOCIATION. Sec.: L. C. Fritch, Cincinnati. Annual meeting, March 17 and 18, Chicago.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION. Sec.: J. W. Taylor, 667 Rookery, Chicago. Meeting, June, 1903.

AMERICAN SOCIETY OF CIVIL ENGINEERS. Sec.: C. W. Hunt, 220 W. 57th St., New York. Regular meetings, first and third Wednesdays of each month. Annual meeting, Jan. 21 and 22, 1903.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Sec.: Prof. F. R. Hutton, 12 W. 31st St., New York. Semi-annual meeting, June, at Saratoga.

BOSTON SOCIETY OF CIVIL ENGINEERS. Sec.: S. E. Tinkham, 715 Tremont Temple. Regular meetings on third Wednesday of each month, except January, when on fourth Wednesday.

CANADIAN RAILWAY CLUB. Sec.: W. H. Rosevear, Jr., Montreal. Regular meetings on second Tuesday of each month.

CANADIAN SOCIETY OF CIVIL ENGINEERS. Sec.: Prof. C. H. McLeod, 877 Dorchester St., Montreal. Regular meetings every alternate Thursday. Annual meeting, Jan. 27, 1903.

CENTRAL RAILWAY CLUB. Sec.: Harry D. Vought, 62 Liberty St., New York. Regular meetings on second Fridays of Jan., March, May, Sept. and Nov., Hotel Iroquois, Buffalo.

CHICAGO ELECTRICAL ASSOCIATION. Sec.: W. J. Warder, Jr., 900 Warren Ave. Regular meetings on first Friday of each month.

CIVIL ENGINEERS' CLUB OF CLEVELAND. Sec.: Arthur A. Skeels, 689 The Arcade. Regular meetings on second and fourth Tuesdays of each month.

CIVIL ENGINEERS' SOCIETY OF ST. PAUL. Sec.: G. S. Edmondstone. Regular meetings on second Monday of each month.

ENGINEERING ASSOCIATION OF THE SOUTH. Sec.: H. M. Jones, 1000 Broad St., Nashville, Tenn. Regular meetings on second Thursday of each month at Vanderbilt University.

ENGINEERS' CLUB OF CHICAGO. Sec.: B. W. Thurtell, 1223 New York Life Building. Regular meetings on first and third Tuesdays of each month.

ENGINEERS' CLUB OF CINCINNATI. Sec.: J. F. Wilson. P. O. Box 333. Regular meetings on third Thursday of each month.

ENGINEERS' CLUB OF COLUMBUS (OHIO). Sec.: H. M. Gates, 12½ North High St. Regular meetings on first and third Saturdays of each month.

ENGINEERS' CLUB OF MINNEAPOLIS. Sec.: Edw. P. Burch, 1210 Guaranty Bldg. Regular meetings on third Monday of each month.

ENGINEERS' CLUB OF PHILADELPHIA. Sec.: L. F. Rondinella, 1122 Girard St. Regular meetings on first and third Saturdays of each month.

ENGINEERS' CLUB OF ST. LOUIS. Sec.: D. W. Roper, 920 Rialto Bldg. Regular meetings on first and third Wednesdays of each month.

ENGINEERS' SOCIETY OF WESTERN NEW YORK. Sec.: L. W. Eighmy, 13 City Hall, Buffalo. Regular meetings, first Tuesday of each month.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA. Sec.: Chas. W. Ridinger, 410 Penn Ave., Pittsburg. Regular meetings on third Tuesday of each month.

FRANKLIN INSTITUTE. Sec.: Dr. Wm. H. Wahl, 15 South 7th St., Philadelphia. General meetings on third Wednesday of each month. Regular monthly meetings of the various sections on other days.

IOWA RAILROAD CLUB. Sec.: P. B. Vermillion, Des Moines, Iowa. Regular meetings on third Tuesday of each month.

LOUISIANA ENGINEERING SOCIETY. Sec.: G. W. Lawes, 806 Gravier St., New Orleans. Regular meetings on the second Monday of each month. Annual meeting, Jan. 10.

MASTER CAR BUILDERS' ASSOCIATION. Sec.: J. W. Taylor, 667 Rookery, Chicago. Meeting, June, 1903.

MICHIGAN ENGINEERING SOCIETY. Sec.: F. Hodgman, Climax, Mich. Annual meeting, Jan. 20, 21 and 22 at Battle Creek.

MODERN SCIENCE CLUB. Sec.: R. Henderson, 302 Livingston St., Brooklyn. Meetings every Tuesday.

MONTANA SOCIETY OF ENGINEERS. Sec.: Richard R. Vail, Butte, Mont. Regular meetings on second Saturday in each month.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Sec.: James B. Cahoon, 130 Liberty St., New York. Meeting, May, 1903, Chicago.

NEW ENGLAND RAILROAD CLUB. Sec.: Edw. L. Janes, Back Bay P. O., Boston. Regular meetings second Tuesday in each month at Pierce Hall, Copley Square.

NEW YORK RAILROAD CLUB. Sec.: W. B. Yereance, 418 Center St., South Orange, N. J. Regular meetings on third Friday of each month except June, July and August, at Carnegie Hall, 154 W. 57th St., New York.

NORTH-WEST RAILWAY CLUB. Sec.: T. W. Flannagan, Minneapolis, Minn. Regular meetings on first Tuesday after second Monday of each month, alternating between Minneapolis and St. Paul.

PACIFIC COAST RAILWAY CLUB. Sec.: C. C. Borton, West Oakland, Cal. Regular meetings on third Saturday of each month, at San Francisco.

PACIFIC NORTHWEST SOCIETY OF ENGINEERS. Meetings monthly in Chamber of Commerce rooms, Seattle, Wash.

RAILWAY CLUB OF PITTSBURGH. Sec.: J. D. Conway, P. & L. E. R. R., Pittsburgh, Pa. Regular meetings on fourth Friday of each month at Hotel Henry.

RAILWAY SIGNALING CLUB. Sec.: B. B. Adams, 32 Park Place, New York. Regular meetings on second Tuesday of January, March, May, Sept. and Nov.

RICHMOND RAILROAD CLUB. Sec.: F. O. Robinson, 8th & Main Sts., Richmond, Va. Regular meetings on second Thursday of each month.

ROCKY MOUNTAIN RAILWAY CLUB. Sec.: J. E. Buell, 906 20th Ave., Denver. Regular meetings on first Saturday after the 15th of each month.

ST. LOUIS RAILWAY CLUB. Sec.: E. A. Chenery, Union Station, St. Louis. Regular meetings on second Friday of each month.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB. Sec.: W. A. Love, Atlanta, Ga. Regular meetings on third Thursday of Jan., April, Aug. and Nov.

TECHNICAL SOCIETY OF THE PACIFIC COAST. Sec.: Otto von Geldern, 31 Post St., San Francisco. Regular meetings on first Friday of each month.

TEXAS RAILWAY CLUB. Sec.: T. H. Osborne, Pine Bluff, Ark. Regular meetings on third Monday of April and September.

WESTERN RAILWAY CLUB. Sec.: Jos. W. Taylor, 667 Rookery, Chicago. Meetings on third Tuesday of each month, Auditorium Hotel, Chicago.

WESTERN SOCIETY OF ENGINEERS. Sec.: J. H. Warder, Monadnock Block, Chicago. Regular meetings on first Wednesday and extra meetings on third Wednesday of each month.

Personal.

—The American Society of Mechanical Engineers elected the following officers at its December meeting in New York: President, James M. Dodge, Philadelphia; vice-presidents, F. H. Daniels, Worcester; James Christie, Philadelphia, and John R. Freeman, Providence; managers, R. C. McKinney, New York; S. S. Webber, Trenton, and Newell Sanders, Chattanooga; treasurer, William H. Wiley, New York.

—Mr. Edwin Reynolds, the great designer of steam engines, past-president of the American Society of Mechanical Engineers, for many years general superintendent of the Edward P. Allis Co., and more recently chief engineer of the consolidated Allis-Chalmers Co., has been made consulting engineer of the latter company, and his nephew, Mr. Irving H. Reynolds, M. Am. Soc. C. E., who has been the general superintendent, succeeds him as chief engineer.

—Mr. Desmond Fitzgerald, past-president of the American Society of Civil Engineers, who has been connected with the Boston Water-Works Department for many years, has resigned from his position as engineer of the Sudbury Department of the Metropolitan Water and Sewerage Board, on account of ill health.

—Mr. Kingsley L. Martin, the assistant engineer of the East River Bridge, who displayed such striking gallantry at the time of the fire on the bridge tower, has received a letter from Mayor Low, in which the latter expresses his high appreciation of Mr. Martin's conduct on that occasion.

—Mr. Eduardo J. Chibas, C. E., who has had a large experience as civil and mining engineer in this country and in Central and South America, and who has recently been manager of the Guantanamo and Caimanera Railway, Cuba, has established an office in Santiago de Cuba, where he will devote special attention to the examination of mining properties on the island.

—Herr Theodore Lewald has been appointed imperial commissioner for Germany to the World's Fair at St. Louis in 1904. He is authorized to select a site and arrange for the construction of the German building, and when this is completed he will start the work of collecting exhibits.

—Mr. E. B. Thomas was elected president of the Lehigh Valley Railroad Com-

pany, and Mr. J. A. Middleton, assistant to the president, at a recent meeting of the board of directors. Mr. Middleton's office will be at No. 26 Cortlandt Street, New York.

—Mr. Charles Parsons, who has been engaged in railroad mechanical work and in the sale of engineering and railroad supplies, has now joined the Chicago Pneumatic Tool Co. and will travel for them in the interests of their products.

Messrs. Dodge & Day, modernizing engineers, will equip the new plant which is being erected for the Heating, Ventilating and Foundry Co., of Pittsburg, at Wheeling, West Va.

—Mr. Salem Howe Wales, the managing editor of the "Scientific American" for many years, died at his home in New York on December 2, at the age of seventy-seven.

—Mr. C. O. Tilton, the secretary of the Railway Signaling Club, who was signal inspector for the Chicago, Milwaukee & St. Paul Railway and had charge of the mechanical part of the signal work of that road, died on Nov. 12, at West Milwaukee, Wis.

Industrial Notes.

—The Cochran-Bly Machine Works, of Rochester, N. Y., the manufacturers of die-making machinery, have recently moved to their new factory on Griffith Street.

—The Harrisburg Foundry & Machine Works announce that the interests of this company centering in and about its New York office, 203 Broadway, and at present under the capable management of Mr. W. P. Mackenzie, having prospered and expanded beyond expectation, will be conducted, hereafter, by the firm of Mackenzie and Quarrier.

—The Cooper-Hewitt Electric Company of New York has been incorporated at Albany with a capital of $2,000,000, to manufacture vapor electric lamps. The directors are: Charles B. Hill, John F. Symes, G. H. Stockbridge, Charles H. O'Connor, and Leavitt J. Hunt, all of New York City.

—The National Machinery Co., of Tiffin, Ohio, reports that business in the bolt, nut and special machinery trade has recently been exceptionally good. Judging from the orders on hand and the inquiries received, and considering the fact that this has been the dull season, the company looks for a large volume of business for 1903. Rumors of decreasing trade are not substantiated, and the company's plant is running to its full capacity to take care of the business in what promises to be the largest year in its history. Foreign trade is picking up, and very substantial orders have been received from France and Germany.

—The New York Continental Jewell Filtration Co. report that they have closed a contract with the Maharaja of Mysore, India, through Captain A. J. de Lotbiniere, Royal Engineers, British Army, who was sent from India to New York by his government for that purpose. The filter plant is to consist of four Jewell gravity filters, each 20 feet in diameter, constructed of granite laid in Portland cement. There will be a masonry subsidence basin holding 400,000 imperial gallons. The capacity of the filter plant is to be 2,600,000 U. S. gallons. It will be erected early in the spring by one of the Filter Company's engineers. It is to be located at Bowringpet in the Kolar Gold Fields, near Bangalore, Mysore. Mr. E. B. Weston, Am. Soc. C. E., is the consulting engineer.

—The Philadelphia Pneumatic Tool Co. has just completed the equipment of Kaiser Wilhelm's new navy yard at Kiel, Germany, with an outfit of Keller pneumatic tools. This is the latest phase of the American commercial invasion of Europe. Looking in the opposite direction, this company reports an increasing trade on the Pacific Coast. Mr. O. A. Berger, the representative of the Philadelphia Company in San Francisco, has just visited the home office, bringing with him some large orders from the various ship yards, steel works, etc., on the Pacific Coast.

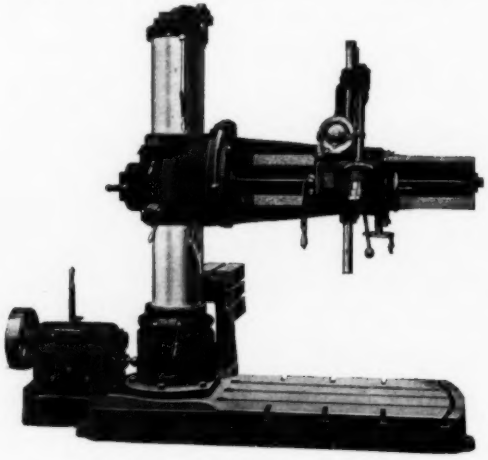
—The Crocker Wheeler Company, of Ampere, N. J., manufacturers of electrical machinery, have included among their recent shipments of engine-type generators one size 336, 400 K. W. for the Stephen Girard Building, Philadelphia; one size 111, 100 K. W., and one size 140, 125 K. W. for the Missouri Pacific Railway, St. Louis; two size 168, 150 K. W. for the Penna. Malleable Co., McKees Rocks, Pa.; one size 224, 200 K. W., for J. L. Mitchell, Philadelphia; two size 168, 150 K. W., one size 224, 200 K. W., and one size 84, 75 K. W., for the

vided with a safety stop permanently secured in the face of the tripping gear, which, when the spindle reaches the end of its traverse, engages positively with the trip lever, thus disengaging the feed, making it impossible to be continued, or the clutch to be thrown in again, until the spindle has been raised.

The arm has an internal locking device which exerts an outward pressure against the ways and practically forms a pipe section to resist the combined stresses of twisting and bending. The base is provided with a circular arc slot from which the end of the arm can be supported when the drill is operating under exceptionally severe conditions. This universal drill, unlike those of other designs, has the tapping attachment on the head, and the hand-wheel for operating the latter is on the head itself immediately in front of the tapping lever.

In the accompanying illustration, the driving pulley, gear box and clutch lever are at the left of the base near the column. The back gears are mounted in a box bolted to the back of the cuff, or sleeve of the arm and are operated through friction clutches and can be engaged or disengaged instantly without stopping the machine. The levers which operate the back gears are shown at the extreme left of the arm. An engraved index plate on the arms enables the operator to see at a glance the proper speed for drilling in either cast iron or steel. The speed box gives 16 spindle speeds when operated in connection with the back gears, which are arranged in geometrical progression from 16 to 267 revolutions per minute. The back gear shaft transmits to the head and through a simple train of gears to the drill spindle.

The feed gear box is mounted on the head immediately to the left of the drill spindle, and contains a nest of gears that gives a choice of eight feeds, ranging in geometrical progression from .007 to .064 inches per revolution. An engraved plate on the front of the feed box indicates the position of the lever for the eight feeds.



BICKFORD UNIVERSAL RADIAL DRILL.

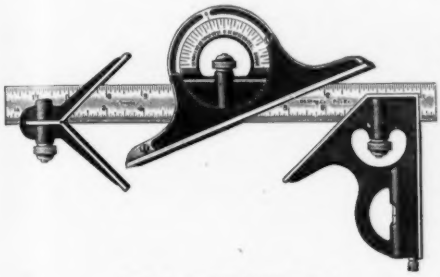
Four styles of this machine are now being built from the designs and patents of Mr. H. M. Norris, the works manager of the Bickford Co., in sizes which drill to the center of 8, 10 and 12-foot circles, respectively. Any further information will be cheerfully furnished by the Bickford Drill & Tool Co., upon request.

"B. & S." Combination Sets.

THESE very useful machinists' tools consist of a combination square and a protractor, with either plain or reversible head, the latter being the form illustrated.

The combination squares were designed and made after careful investigation by ex-

pert mechanics as to the requirements of such tools. The heads are of steel, drop forged and superior to those of cast iron. This feature is readily appreciated by mechanics, as it contributes much to the lightness, durability and convenience of the tool. These squares are also furnished with hardened heads, the advantages of which are readily apparent. An important feature is the round clamping groove in the blade. This allows the head to be quickly clamped and forces the blade against the side of the slot square with the face of the head. It also admits the use of a stronger blade and clamping bolt than does the usual square groove, and presents no sharp corners to collect dirt and impair the accuracy of the tool. Another important feature is that all parts of these squares are made interchangeable, thus allowing repairs to be made by



B. & S. COMBINATION SET.

simply ordering the part needed and avoiding the necessity of returning the tool.

The protractor consists of a blade either tempered or soft, as may be desired, which is accurately graduated with the same care and attention to detail as are the Brown & Sharpe standard rules, which have become recognized as standards for their accuracy and quality of workmanship. This blade differs only from the rules mentioned in that the figures are heavily shaded, and have not the single line which is usually employed. This is a feature that has been much appreciated, as it enables the figures to be more easily seen and carries with it a distinctiveness that is readily valued. The head is about 7 inches long by about 1 inch wide, extending practically ½ inch on each side of the blade. This feature is much liked by pattern makers and others who have occasion to transfer angles from one side of a piece to another; and is useful in laying out angles on opposite sides of the piece. This can be done without the necessity of re-setting the head, as would be necessary where the measuring is on only one side of the blade.

The blade is held in a revolving turret that is accurately engine divided to 90° either side of the zero and fitted to a nicety, giving a uniform movement. The clamping post is the same as that used in the combination squares, having a rounded end that fits the round clamping groove back of the blade. The level, which forms so important an adjunct to a tool of this kind, is accurately set for parallelism and rigidly clamped into position. Recognizing the fact that this is such an important part of a tool, it is included in the price.

That part of the head which extends beyond the front of the blade can be removed, if desired, and the head used in the same manner as the ordinary protractor head. In this way the second zero, opposite the one shown at the top of the head, may be made use of, as at many times, when setting planer work or on work of a similar character, the blade is in such a position as to obscure the zero shown at the top, and readings can then be made from the zero at the bottom. Every care is taken in establishing these zeros to insure their being at right angles to the face of the head.

The Brown & Sharpe Mfg. Co., of Providence, R. I., will be glad to furnish any further information concerning these instruments which may be desired.

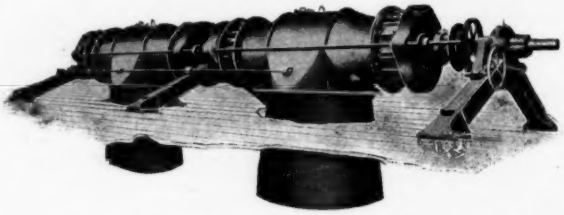
The Turbine Equipment at the "Soo."

THE magnificent power station of the Michigan-Lake Superior Power Co., at Sault Ste. Marie, which was put into commission a few weeks ago, is the largest example extant of the application and development of water power from a low head. While the preparatory work necessary to make this a successful installation did not call forth the combined skill and efforts of hydraulic engineers in all parts of the world, as did the Niagara Falls equipment, yet it took months of experiment and study before being perfected, and as installed has at least one point of advantage over its great rival.

in that the turbines have a far greater efficiency than those at Niagara. The type of turbine used in the "Soo" plant is the well known McCormick turbine, which might well be termed the standard type in this country. When originally brought out, the tests made on it showed it to be far in advance in points of efficiency, power, and speed, over any of the turbines then on the market. While there have been other turbines designed since then, and all showing fine results, the McCormick still retains the lead.

The usual method of setting turbines has been to place the wheels so that they revolve in a horizontal plane, the shafts being vertical. With the advent, however, of expansion in the electrical fields, and the application of water power to the generation of electric currents, it became necessary to set turbine wheels in a vertical position on horizontal shafts. When the Michigan-Lake Superior Power Co. prepared its plans for the new power house, this setting was finally determined on as being the most economical, and proposals and plans were invited from turbine builders. Up to this time all tests of wheels had been made on a vertical step at the Holyoke Water Power Co.'s flume in Holyoke, which is at present the most reliable testing station, as it was designed by Francis and constructed by Clemens Herschel. This type of flume was used by Francis to obtain his formulae for calculating water powers, which are authoritative to-day. To make tests on wheels in a horizontal setting required considerable expenditures, and an arrangement was finally entered into between the Power Company, The Webster, Camp & Lane Co., and J. & W. Jolly, Holyoke, to design, build and test a turbine unit which should fulfill the following requirements: With a sixteen-foot head, the unit must develop 568 horse power at 180 revolutions, with an efficiency of 80 per cent. The tests were to be made at Holyoke under the supervision of Prof. G. S. Williams of Cornell University. After many months of experimenting with improved forms of wheels and various designs of draft cases and draft tubes, the final design, as illustrated, was adopted. The best results finally obtained were as follows: Head, 16 feet; speed, 180 revolutions per minute; horse power, 584; efficiency, 84 per cent. These figures speak for themselves.

The penstock unit as shown in the figure consists of four turbines, arranged in pairs with one draft tube for each pair. Each pair is keyed to an open-hearth hammered steel shaft, and the two shafts are bolted together by means of forged couplings. The shafts are designed to transmit double the power of the generators, with the usual factors of safety. This is to provide against the torsional vibrations caused by generating an alternating current. Each pair of turbines discharges into a central, conical-ended draft case, and the discharge is continued to the tail-race by means of a conical steel plate draft tube. The draft cases are made of cast iron, and are separable in a horizontal plane parallel with the turbine shafts, making them easy of access. The center of each case is provided with a yoke or steady rest for the turbine shaft. The combined water-wheel shaft is supported by three heavy cast-iron pedestal girders that rest on the side or foundation walls of the penstock. The water bearings are amply large and are made from specially prepared wood blocks. These are backed with iron and can be adjusted for wear. The draft cases are supported by heavy spanning frames made from 15-inch steel I beams.



TURBINES AT THE "SOO" PLANT.

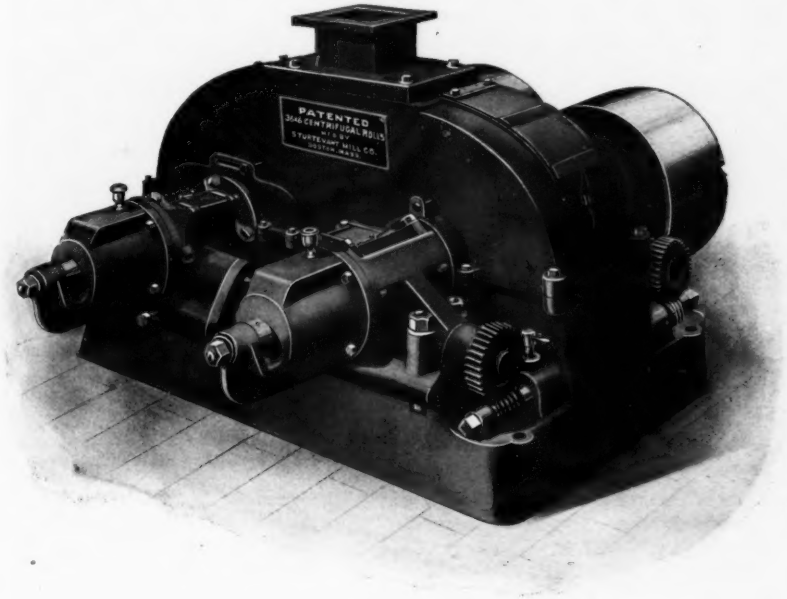
These also rest on the side wall of the penstock. This construction frees the arches over the tail-race from the weight of the machinery. The draft cases and pedestal girders are tied together on each side by longitudinal bars, making a substantial and ideal support for the running parts. The turbine shaft penetrates the curved bulkhead by means of a stuffing box properly secured to the steel plates by rivets. The common horizontal gate shaft extends through the bulkhead into the dynamo room in like manner, and is provided with the necessary rigging to manipulate the gates of the four turbines simultaneously by hand or by machinery.

The turbine shaft at the end farthest from the dynamo room is 5½ inches in diameter and increases in size until it is 7¼ inches in diameter at the dynamo end, and is arranged to be coupled to a horizontal dynamo. Each of the four turbines is encased in a balance-gate curb, while the individual gates are so poised as to direct the flowing water properly, and differently at the different degrees of gate opening, thus maintaining a high efficiency at part gate.

Any further information concerning these turbines will be gladly given by the Webster, Camp & Lane, Akron, O., who are the manufacturers.

Centrifugal Crushing Rolls.

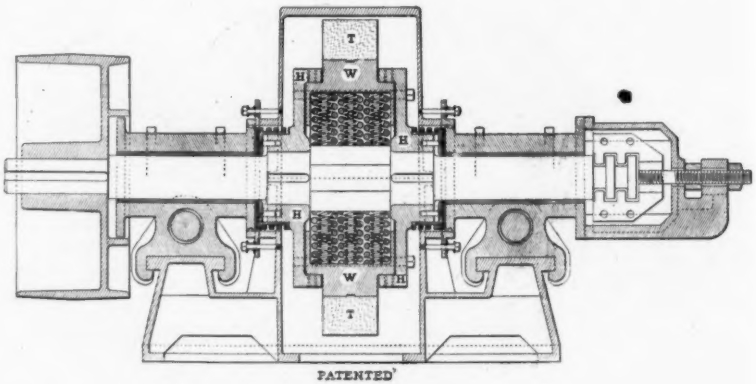
THE 36-inch centrifugal rolls here illustrated, are the largest made by the Sturtevant Mill Company. The tires are 4½ inches thick, are of high carbon steel, and have sixteen tons pressure at ordinary speeds. They can be run as fast, or as slow, as required, and attain greatly increased pressures when fast running brings in the rapidly augmenting centrifugal forces. These rolls have none of the destructive vibrations noticed in all other rolls, for their shafts are fixed. They turn easily with one belt. The bearings are dust-proof, and the side adjustments remarkably simple and durable; tires may be removed in a few minutes. It is only necessary to turn in set screws in the head peripheries:



CENTRIFUGAL CRUSHING ROLLS.

these press back the tire spring weights; then the tire is released, and may be slipped off easily. When tires are replaced the set screws are taken out, and the tires at once secure themselves.

The manufacturers argue briefly the questions of large and small roll constructions in the following interesting manner: Since rolls crush by the pressures of their revolving tire surfaces, it is plain that if the tire widths and pressures are the same the output of all rolls will be in exact proportion to tire velocities, regardless of diameters. A small roll, therefore, may do as much as a large one, if the tires can attain the same speed.



CENTRIFUGAL CRUSHING ROLLS.

That they can do this in centrifugal rolls is beyond doubt, for they run easily at almost any speeds, high or low; and the tire surfaces of the smallest centrifugal rolls can equal the travel of the largest roll tires that can be constructed, and do as much work for the same width of tire.

What, then, is the advantage of the large, expensive common roll? The large common roll has greater grasp, and can seize and break large rock. It is a coarse crusher; the small centrifugal roll, on the other hand, is a finisher.

But the large rolls pay dearly for this single point of advantage, and the work they do can be much more cheaply done in a roll jaw fine crusher. Large rolls cost more to buy, to transport, and to run. The shocks of crushing on their heavy backward and forward moving parts are destructive: repairs are expensive, and their big tires are not taken off or replaced easily. Centrifugal rolls on finishing work run with nearly the quietness of dynamos. They can easily surpass, in any size, common roll velocities; and just here is met a consideration of great practical importance.

In roll crushing, there is found for each ore, a tire speed that gives the largest output per pound of tire wear. This can only be determined by experience. In most cases this economical speed is found to be far above the turning ability of common rolls. Any centrifugal roll can run to that speed, and no other rolls can.

The wear of a small tire surface, even when running at the tire speeds of the largest rolls, is no greater than that of a large tire having the same velocity. In both cases the same amount of metal is exposed to wear in the same time. The smallest rolls, however, must not be used as coarse crushers; although in everything else they are superior.

Large centrifugal rolls can run even on large rock at much higher speeds than common rolls, and are well suited to either coarse or finishing work. In most cases centrifugals do three times as much as common rolls of equal size.

In a handsome circular of crushing and grinding machinery, which the Sturtevant Mill Company, of Boston, Mass., issue frequently, and gladly send to inquirers, this matter is further considered.

THE ENGINEERING MAGAZINE

THE WORLD IS ITS FIELD

VOL. XXIV. JANUARY, 1903. No. 4.

LAKE BOHIO
THE SUMMIT LEVEL OF THE PANAMA CANAL.

By George S. Morison. With an Editorial Introduction.

As Member of the Isthmian Canal Commission, Mr. Morison gave particular attention to the Panama Canal route and the several proposed Darien lines. With his pre-eminent rank as an engineer and this intimate familiarity with the special problem under discussion, he is easily a foremost authority upon what might, perhaps, be termed the American plans for the great waterway. His article following is primarily an answer to the argument for the "two-lake" projet of the *Comité Technique*, so earnestly supported by Gen. Abbot in our preceding issue. In effect it is more—it is a brief statement, admirable for its conciseness and sufficiency, of the Isthmian Canal Commission's solution of the two great problems of the work. How different was their position from that of the French engineers in approaching the study—how much greater their freedom to consider the problem as a whole—Mr. Morison explains clearly. In the light of his discussion, one suggestion of our editorial introduction to Gen. Abbot's paper must be withdrawn—that is, that the Commission felt itself too limited as to time for a decision upon working plans. The projet outlined by Mr. Morison is not merely sufficient for comparative estimates, but, in the Commission's opinion, best for the building of the Panama Canal. THE EDITORS.

THE Panama Route was selected more than twenty years ago by the Congress of Paris as the best location for a canal across the American Isthmus. The wisdom of this selection has

been confirmed by the Isthmian Canal Commission, which advised the selection of the same route as the one best adapted for a canal to be built by the United States Government. The Panama Route does not have the lowest summit and it is not the shortest line. The lowest summit is on the Nicaragua Route and is nearly 150 feet lower than the natural summit at Panama. The shortest route between the two oceans is the San Blas Route which is nearly 10 miles less than the Panama Route. But the Nicaragua Route, in spite of its low summit, is four times as long between oceans as the Panama Route, and the San Blas Route with its short distance has a summit four times as high as the summit at Panama. There is no single feature of the Panama Route which is not inferior to a corresponding feature of some other route. On the other hand, there is no route in which the worst feature is not a great deal worse than the corresponding feature at Panama. After balancing all the Panama Route comes out ahead. The two serious features of the Panama Route are the control of the Chagres River and the summit cut at Culebra. Each of these permits of an entirely satisfactory solution and when the work is completed no further difficulties are to be anticipated from either. In considering the best plan for a canal these two constructive features must be taken together.

The study of the Chagres River, which was made by the New Panama Canal Company from records collected at the Isthmus and collaborated in Paris, has been of an exhaustive character and of the greatest value. The results of this study are embodied in the article in the December number of the ENGINEERING MAGAZINE by Gen. Henry L. Abbot who, as a member of the *Comité Technique*, was especially selected to develop the results of these observations. The principal features of the article were presented to the Isthmian Canal Commission in Paris in 1899, since which time the records of three years have been added, the full benefits of which are now given. The conclusions of Gen. Abbot as expressed in this article, giving the leading features of the discharge of the Chagres, may be accepted as the latest and most complete information on the subject. They differ from the data used by the Isthmian Canal Commission only in being in greater detail and somewhat less extreme both in maximum and minimum amounts, the Commission having selected a minimum discharge somewhat less than any observed minimum and provided for a maximum somewhat in excess of any calculated maximum.

The conclusions of Gen. Abbot may be briefly stated. The maximum flood in the Chagres occurred in 1879 and produced a discharge

of 78,614 cubic feet per second at Gamboa, which is approximately the point where the canal leaves the Chagres valley to cross the divide, and of 112,730 cubic feet per second at Bohio where the dam across the Chagres would be located. Gen. Abbot estimates that this flood discharge at Bohio may have averaged 104,600 cubic feet for 37.3 hours. The next greatest flood occurred in 1888 and amounted to 79,000 cubic feet at Bohio and to 64,488 cubic feet at Gamboa. The conclusions of the Commission were that the canal should be so designed that a flood representing a discharge of 75,000 cubic feet per second at Bohio would not interfere with navigation and that a flood of 140,000 cubic feet per second would do no permanent injury to the canal. The accommodation of floods of this magnitude is simply a question of size of channel. The Commission adopted a speed of three feet per second, about that of the Detroit River in front of the city of Detroit, as the limit which would not disturb navigation, and about twice this speed as the limit which would not injure the works of the canal. The minimum average discharge of the Chagres in any month at Bohio occurred in April, 1901, when it averaged 565 cubic feet per second.

If a tide-level canal were to be built the Commission was of the opinion that it would be necessary to hold back the floods of the upper river by impounding them in a lake above a dam at Alhajuela and to make the canal, which would necessarily be in the lowest part of the valley, of such dimensions that it would safely carry off the remainder of the flood. If, however, a high-level canal were adopted, the area of the channel everywhere could easily be made adequate to take the entire discharge of the Chagres at a speed which would not even interfere with navigation. It was also manifest that the higher the level of the lake, the larger would be its cross section everywhere and this relative increase would be greatest in the most constricted places. Furthermore, as it was considered important to make the lake the summit level of the canal, the height of this lake fixed the depth of the great Culebra cut, the importance of which is manifest from the fact that each foot of increased depth of cut represents more than 300,000 cubic yards of excavation, with a corresponding expenditure of money and, what is more important, of time in the completion of the work.

The Commission adopted a height of 90 feet above mean tide and five feet above the crest of the spillway, as the maximum level for Lake Bohio; this is about 18 feet higher than the level selected by the French engineers and recommended by Gen. Abbot. This change

represents a corresponding increase of depth of water in nearly the whole area of Lake Bohio and a reduction of something like 6,000,000 cubic yards of excavation in the Culebra cut.

Besides increasing the depth and area of the lake, and thus facilitating navigation, this change extended the lake up the valley of the Chagres nearly to the site of the proposed Alhajuela dam, this extension of lake having one advantage of which little has been said. The upper Chagres is a clear mountain stream with rocky banks and rapids over coarse gravel or boulders. It shows no sign of silt and there need be no fear of its bringing down material which would cause sandbars and deposits below. A few miles below Alhajuela the character of the banks changes, and fine material is found which is washed away during freshets and produces silt and sandbars below. With the lake at the higher level all this soft material would be perpetually submerged in positions where there would be little danger of washing, and the amount of silt brought into the lake would be very greatly diminished.

The only objection that can be raised to this increased height of lake is the additional lockage required to approach it in each direction, and the additional height of dam.

As to the first objection, the plan of the Commission involves no more locks on the west side than the plans of the French Company, and the lifts of these locks do not exceed the lifts proposed by the French engineers for the locks on the east side. On the east side the plan of the Commission proposed locks of the unusual lift of 42 feet; that such locks are practicable no engineer will deny. If, however, it is thought important to keep the lift down to the limit of about 10 meters, adopted by the French engineers, it is perfectly possible to use three locks instead of two, two of the three to be located at the Bohio site and the third lock either at Peña Blanca or at Tiger Hill as will be explained hereafter.

So far as the dam is concerned the maximum height selected by the French engineers seems to have been adopted on a purely arbitrary basis. With some modification in dimensions and construction a dam 90 feet high will be as safe as a dam 70 feet high. The head of water against the dam can be reduced by raising the level below as well as by reducing the level above, and if a third lock is used the level below will be raised so that the head against the dam will not exceed that contemplated by the French plans. Moreover, while the author is convinced that the amount of seepage under the dam will be insignificant even with the increased head. there are various ways by which the flow of water through any permeable material below the present bed

of the Chagres can be cut off, some of which methods would not involve an unreasonably large expenditure.

The French plan proposed to limit the amount of water which should be admitted into Lake Bohio from all sources at any time to about 33,000 cubic feet per second. The discharge was to be taken over two spillways, both regulated by systems of sluices, through diversion channels on each side of the canal, to the sea, while the control of the lake was also to be handled through regulating works in connection with the upper dam at Alhajuela. Apparently the ability of the diversion channels below to carry off the discharge was the principal measure which limited the supply of water to be admitted into the lake at any one time. The scheme was very carefully worked out and there is no doubt that it would be effective. The Commission, however, considered it unnecessarily complicated and it involved a personal element in the working of the sluices which it was desirable to avoid. It was necessary not only to regulate the height of the water in the two lakes as floods increased, but to apportion the discharge of Lake Bohio between the two separate diversion channels.

The surveys made by the New Panama Canal Company revealed the fact that near the head of the Gigante, a small tributary of the Chagres above Bohio, there was a gap at an elevation 65 feet above tide water, through which the overflow of the lake could be taken into the lower valley of the Chagres. This was a comparatively late discovery, but the location was at once adopted for one of the two spillways. The beauty of this location for a spillway was its distance from the dam and the line of navigation, while borings showed a good rock bottom on which a masonry structure could be founded. The area of the lake is about 1,000,000,000 square feet. Calculations showed that a fixed spillway 2,000 feet long at this place would carry off a discharge of 80,000 cubic feet per second, with the water five feet above the crest of the dam, and a discharge exceeding 100,000 cubic feet with the water six feet above the crest. With such a spillway the regulation of the lake would become entirely automatic. It would be the simplest kind of a hydraulic problem. During any period of excessive rainfall, no matter how long continued, the waters of the lake would rise until the flow over the spillway equaled the flow into the lake. When the excessive rains were over the lake would continue to fall until a condition of equilibrium was reached again. Except during extreme floods the discharge from the lake would seldom maintain the water more than a foot above the crest of the spillway; a rise of four feet in 48 hours

would represent an average storage in the lake of 23,000 cubic feet per second; a flood equal to that of 1879 would probably never involve a discharge of over 80,000 cubic feet per second over the spillway. But even if an extreme flood beyond all precedent and of indefinite duration should occur, it would simply mean a slight further elevation of the surface of the lake; there is a large margin for safety and ignorance. The absolute simplicity and automatic character of this arrangement made it one of the most satisfactory solutions of a hydraulic question which has ever been reached. The channels in the more constricted portions of the lake are abundantly adequate to take care of the flow of water. The spillway is abundantly large to carry off any discharge.

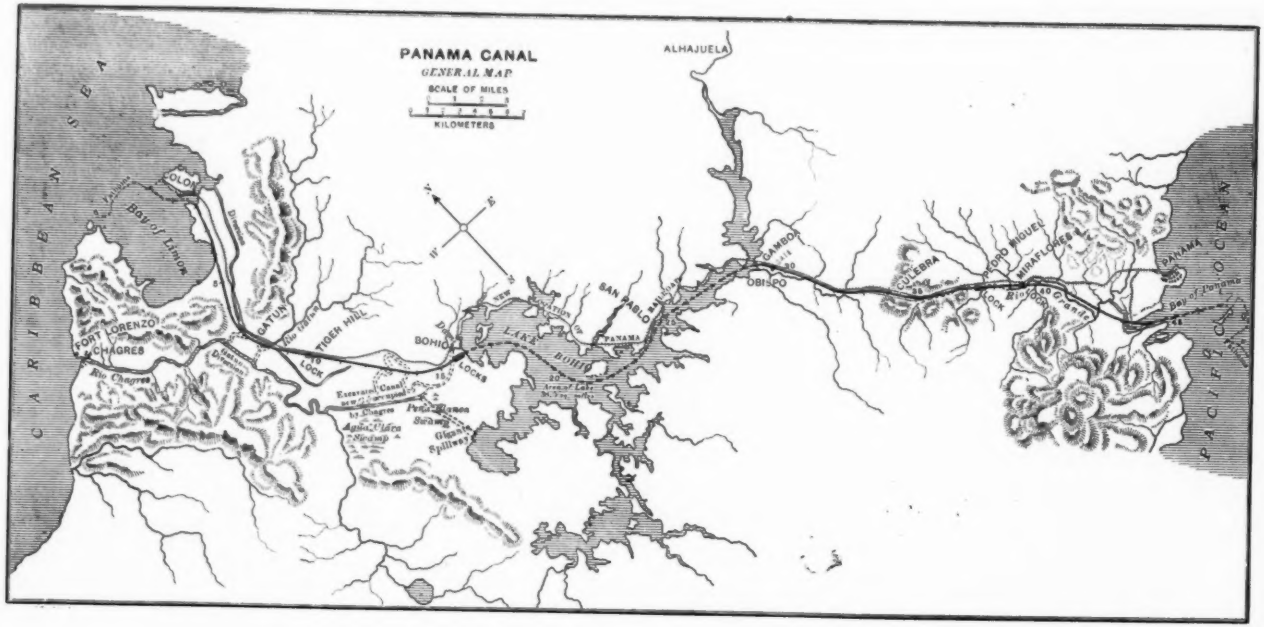
There remain but two problems. The first is the supply of water during the dry season when the discharge of the river is not adequate. The actual demands of the canal for lockage, leakage, evaporation, and all other usual requirements are not far from 1,000 cubic feet per second. The actual deficiency in any one year would be less than 3,000,000,000 cubic feet. The plan of the Commission contemplated making the channel through the lake and the summit cut sufficiently deep to allow the lake to be drawn down three feet to supply this deficiency of water. There are other means of supplying it. It is not improbable that the wisest course would be to build the upper dam at Alhajuela and provide for this additional storage in an upper lake; in the writer's mind the principal reason for doing this would be to reduce the depth of excavation through the Culebra cut.

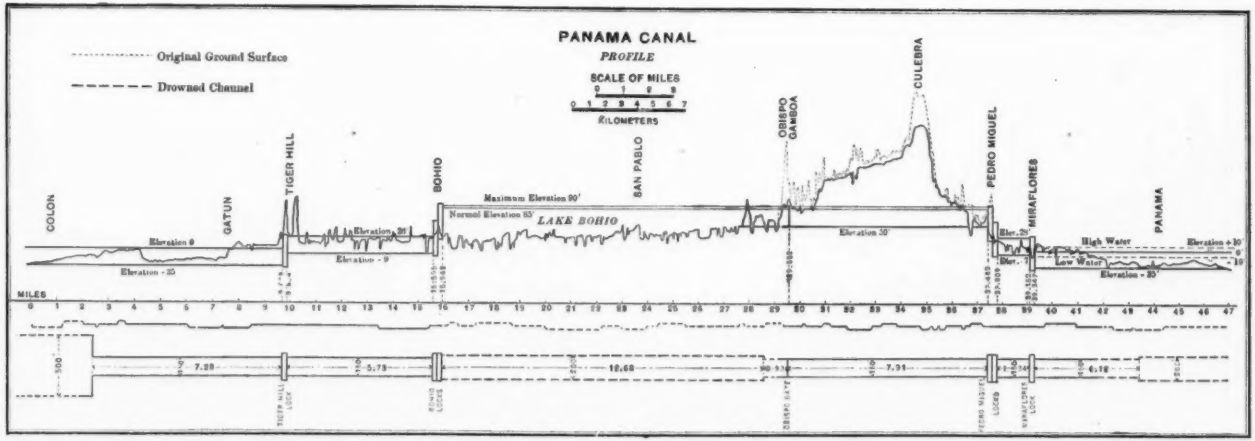
The second problem is the disposal of the water after it has left the spillway. The location of the Lesseps tide-level canal followed the lowest portion of the valley of the Chagres and this canal was supposed to be completed to within two miles of Bohio. It crossed the Chagres several times and for a length of about three miles the canal excavation has become the main channel of the river, which has abandoned its more circuitous natural course. The spillway is about four miles from the navigable channel in Lake Bohio and more than two miles from the canal below the locks. The canal continues in this low country to Gatun, from which point it bears northerly to Colon while the Chagres River flows westerly to its mouth. A series of swamps lie between the line of the canal and the hills. The discharge over the spillway would be taken through these swamps and would be kept out of the canal by a series of levees made of material excavated from the bed of the canal. At Gatun, however, the course of the canal crosses the Chagres and the valley between the hills is contracted.

At this point it would be necessary to cut a large deep channel across the peninsula made by a bend of the river and at a safe distance from the canal, through which the floods would be diverted. This diversion channel, with the aid of a channel between two of the swamps and the protection of the levee on the exposed side of the canal, would send the maximum discharge of the spillway safely to the sea.

There is another solution of this problem which would probably be less costly and which the writer prefers. This scheme was regarded with favor by the Isthmian Canal Commission and a survey was made of the line it would follow, but it was considered premature to adopt it for the estimates of the Commission's report. It contemplates keeping east of the lowest part of the valley, following substantially the route of the Panama Railroad from Bohio to Gatun where it would join the French location. This line would save a mile and a quarter of distance and would leave the present canal and the lower valley of the Chagres entirely free to take the discharge of the spillway. Furthermore, at Tiger Hill there is an excellent site for a lock and the canal could be carried on an intermediate level, about 26 feet above tide water, from the Bohio locks to this point, thus reducing the lift of the Bohio locks and the head of water against the dam. If this line was adopted the discharge from the spillway would nowhere come within half a mile of the canal, and then only through the deep channel opposite Gatun where it would be defended by rocky banks. For much of the length the canal would be carried at a level safely above any possible discharge. This route is shown on the map and the profile which accompany this article.

Comparing the plan adopted by the New Panama Canal Company with that recommended by the Isthmian Canal Commission the very different circumstances under which their work was done should be remembered. This difference lies not so much in the time available for study as in the general problem which each had to consider. The French Company found itself with an unfinished property on which enormous sums had been expended, which was worse than useless in its present condition, and which could be saved only by completing it in the shortest possible time and with the least possible expenditure of money which was yet to be obtained. So marked were these conditions that the plan advocated by Gen. Abbot, of two lakes the level of the lower and larger of which was to extend through the Culebra cut, was rejected in favor of a plan in which the summit level was placed 45 feet above this lake and reached from the lake by a flight of two locks, while a feeder of complicated and difficult construction

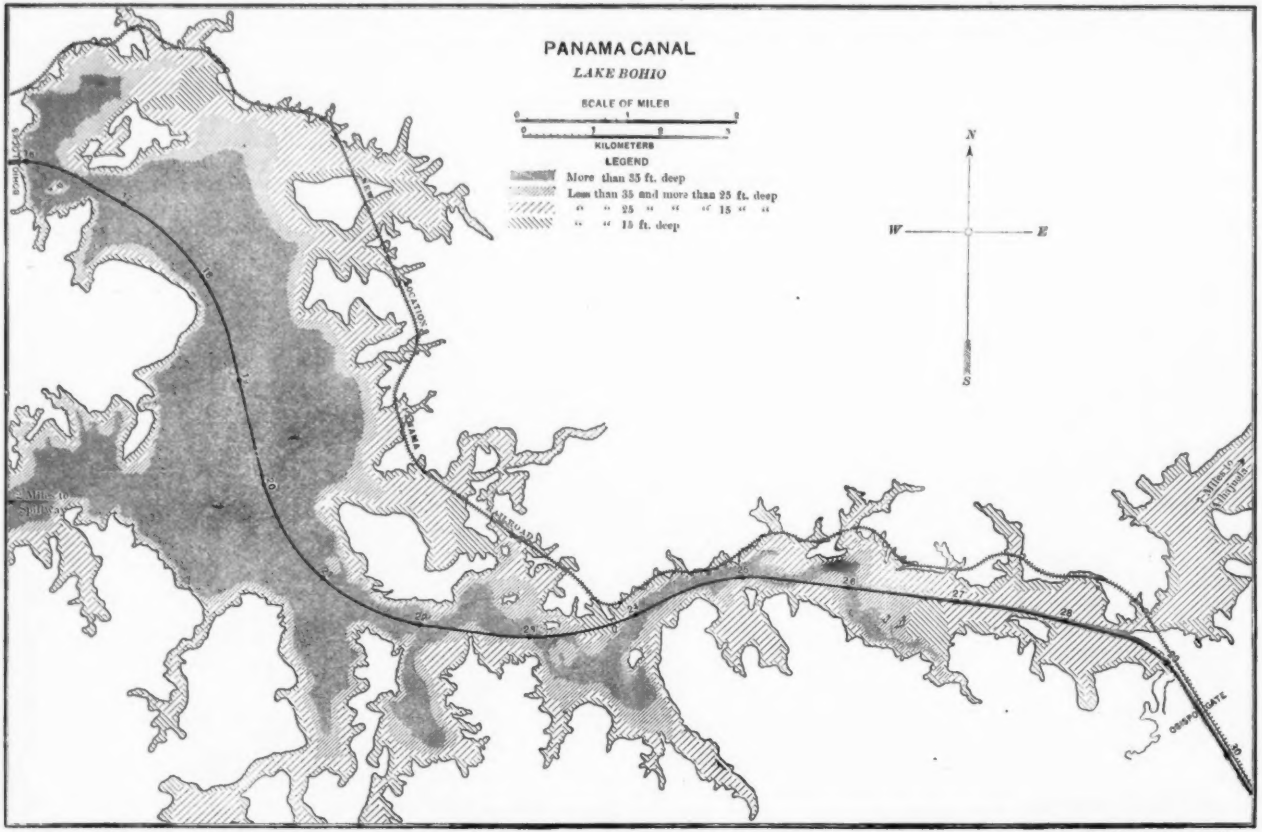

PANAMA CANAL
GENERAL MAP
SCALE OF MILES
KILOMETERS
CARIBBEAN SEA
PACIFIC OCEAN
COLON
Bay of Limon
Limon
Bay
Breakwater
ALHAJUELA
CATUN
Old Bed
TIGER HILL
FORT LORENZO
CHAGRES
Rio Chagres
Gatun Dam
Gatun Locks
Excavated Canal
Proposed Canal
Pedro Miguel
Swamp
Gamboa
Spillway
Agua Clara
Nipmp
BOHIO
LAKE
Bohio
Locks
SAN PABLO
PANAMA
Ancon Hill
Ancon Lake
SAMBOA
OBISPO
CULEBRA
Culebra Cut
PEDRO MIGUEL
MIRAFLORES
Rio Grande
Panama
Bay of Panama



MAP AND PROFILE OF THE PANAMA CANAL ACCORDING TO THE PROJET OUTLINED IN THIS PAPER.

In the map above, the canal proper is indicated by a full line, the drowned channels by broken lines. The scale of the map is too small to show the topography around the lake which is everywhere surrounded by high hills.

In the profile below, the irregular line below the scale of miles indicates the alignment. The width of the canal is indicated below this; attention is called, however, to the fact that the drowned channel in Lake Bohio is really only a theoretical channel, the lake being very much wider.



This map gives the depth of water at normal stage, that is, when the level of the lake is that of the crest of the spillway. During floods the depth would be increased by the height which the lake is raised by the passage of water over the spillway. Attention is called to the two steamers shown at anchor.

was provided to supply the summit level from the upper lake above the Alhajuela dam. This plan was but little less costly than the plan which made the lake the summit level, but was adopted because it was thought that it could be completed in two years less time. The French Company adopted a bottom width generally of about 100 feet and a depth of nine meters, about 29.5 feet, but in the portion of the canal through the low country north of Bohio the plans showed the original dimensions adopted more than twenty years ago by Lesseps with a bottom width of 72 feet. It was also impressed with the value of the work already done and felt it necessary to use as much of it as was possible. The Isthmian Canal Commission had a different problem; the canal must be the one best adapted to the demands of commercial and military service. The depth was increased to 35 feet, the bottom width to 150 feet, and the greater the amount of free navigation with broad channels the better. Instead of using the old channel of the contracted Lesseps dimensions between Bohio and Colon, its plans were based on full dimensions here, although this enlargement involved the removal of a very large portion of the spoil banks deposited when the original excavation was made, and made the amount of work to be done here almost as great as if nothing had ever been done. The Commission felt less bound by the value of old work, discarded partially completed diversion channels which did not appear to be in the best location, and generally endeavored to get the canal which would be most satisfactory when done within reasonable limits of time and cost.

The Commission's plan lends itself to the opening of the canal before it is completed in its entirety. Much of the structural work can be deferred until the canal is actually put in service. The Gigante spillway, the Bohio dam, and the diversion channel west of Gatun must be completed. All the locks are in duplicate, and the construction of the second lock can be postponed till after the opening of the canal. The provision for additional storage of water to supply the waste of the dry season can also be deferred.

In one important respect the French Company and the Commission were guided by the same idea; they both felt that is was necessary to complete the canal as early as could well be done, and to accomplish this the depth of the Culebra cut must be reduced as much as possible. The method adopted by the French Company to accomplish this end was the higher summit level through the cut. The method adopted by the Commission was to raise the level of Lake Bohio. The original Lesseps plan was for a sea-level canal. This plan was rejected by

the new French Company for three reasons; the difficulty of controlling the Chagres, the great cost of the Culebra cut, and the time required for its construction. It was also rejected by the Commission, which felt that the Chagres could be handled even with a tide-level canal, that the cost of the excavation was not enough to be prohibitory, but considered the time required to complete such a canal so great as to outweigh all other considerations.

The advantage of the interior lake is not merely the control of the Chagres and the water supply of a summit level; it will be a great aid to navigation. The total area of the lake it about 40 square miles, of which 10 square miles are more than 35 feet deep at normal stage and more than 40 feet deep during times of extreme flood. This lake is shown on the accompanying plan. It forms an interior harbor nearly as large as the upper bay in New York Harbor, and will have all the advantages of a fresh-water anchorage which have been ascribed to Nicaragua while it is not so large as to be troubled by the waves which limit the anchorages of its larger rival to the more protected localities. The plate shows two steamers at anchor in Lake Bohio, one of them as large as the Oceanic, which give some idea of the available room. In many ways the existence of this lake is an important advantage which would be lost in a tide-level canal. It is about equally distant from the Caribbean Sea and from Panama Bay. It will be the natural meeting point for steamers. The whole transit will consist of two canals and an intermediate lake, all three of about equal length. The passage through each canal, including the locks, will take from four to five hours; the passage of the lake one or two hours more. Ships starting from either terminus in the early morning will meet in the lake, and pass out into the further ocean at twilight. Ships starting at noon will probably spend the night in the lake and proceed in the morning.

While the author does not believe that the Alhajuela dam will be needed during the early years of canal operations, and considers that with a lake of the enlarged dimensions adopted by the Commission it will never be required for the purpose of controlling floods, he does think that the upper lake will prove the most economical and satisfactory method of storing the reserve water which will be required for use during the low-water season as traffic through the canal increases. His own studies have confirmed the conclusions of Gen. Abbot, "that all the water that can ever be demanded by any probable traffic" can be obtained from the Chagres, even though the traffic is several times the 23,000,000 tons suggested as a maximum.

FOUNDRY MANAGEMENT IN THE NEW CENTURY.

By Robert Buchanan.

II.—CRANE SERVICE FOR THE FOUNDRY FLOOR.

Mr. Buchanan's series began in our preceding number with an article on "The Economical Production of Castings," concerned chiefly with the general arrangement of the foundry, the question of heating and ventilation, and the supply of tools and minor plant. The present section takes up the crane service and the drying of cores and moulds. The next paper will deal with "Moulding by Hand and by Machine."—THE EDITORS.

IF all foundry appliances, the cupola alone excepted, cranes rank highest in importance. An ample crane service, as well as speed and nicety of movement, have an incalculable effect in producing the proper spirit and tone in which the work should be carried on. In short, if the cranes are slow, the pace will surely be slow; if fast, then the work can be and ought to be smartly produced. With bad or indifferent cranes and deficient crane service, bad results are certain.

I have already indicated that jib cranes occupying the middle of the foundry floor, whatever their services in the past may have been, are an anomaly and a hindrance in these times. There is one position in which a jib crane excels all others, and one only, and it does not come within the scope of these articles. Nothing can excel a jib crane placed at the raised centre of a circular pit in which pipes are cast on end; but in any other foundry and in any other circumstances jib-cranes are best relegated to a position away from the centre of the foundry floor and to a secondary position as auxiliaries to travelling cranes. In proof of this contention I need only mention the restricted sphere of action of the jib crane, the awkwardness and loss of time with which any ladles, moulding boxes, large cores, etc., are transferred from crane to crane, and the general dislocation of moulding operations which ensues when this is being done. As an auxiliary, the jib crane is in its proper sphere, and that a useful one. An arrangement of jib cranes which in practice has been found most serviceable, is one in which a crane is placed at each pillar, each crane having a radius greater than half the distance between it and the

the new French Company for three reasons; the difficulty of controlling the Chagres, the great cost of the Culebra cut, and the time required for its construction. It was also rejected by the Commission, which felt that the Chagres could be handled even with a tide-level canal, that the cost of the excavation was not enough to be prohibitory, but considered the time required to complete such a canal so great as to outweigh all other considerations.

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FREAKS AND FALLACIES IN STEAM-ENGINE DESIGN.

By Egbert P. Watson.

Mr. Watson's long experience in the field of steam engineering has covered a considerable portion of that wonderful advance which was recently reviewed in these pages by Mr. W. M. McFarland, in his series on "The Growth of Economy in Marine Engineering." In the following article Mr. Watson takes up some of the false steps by which ignorant or dishonest inventors have strayed from the true line of advance.—THE EDITORS.

THE work of the world is practically done by one type of engine—a circular disk piston working in a cylinder, driving a shaft through the media of cranks and connecting rods. I have, perhaps, been needlessly explicit in specifying a circular piston, but in view of the fact that there are, or have been, many kinds of pistons for steam engines, it is not improper to designate the one which experience and precedent have found to be the most suitable. Many years ago (1844) Captain John Ericsson designed and built engines for the United States steamer Princeton; these had pistons rectangular in profile which worked in a semi-cylinder, the same as a door swings on its hinges. Not very long ago I saw an engine with a piston which was hemispherical, bisected in a plane obliquely to its normal axis; I say piston, but this was really only a portion of it, for there was a further detail consisting of two vanes working through slots in the hemisphere that received the actual pressure of the steam. Square pistons reciprocating in square cylinders have also been constructed, and pistons which were a section of an annulus, reciprocating in annular cylinders. But the engine which has done the principal work of mankind—at least up to the present period marked by the promising advent of the steam turbine—is of the type described at the beginning of this article, and its adoption has not been dictated by fancy or the whims or notions of manufacturers, but simply by the fact that it has given the highest efficiency known. That is to say, a given weight of steam in a reciprocating-piston engine, with a circular piston, has given the most power for the least expenditure.

This knowledge has been dearly bought, for men in all ages, from the first inception of the steam engine, have worshipped strange gods in its likeness, only to find that they had wandered far from the truth.

I might call these departures "freak engines" because they are curious examples of aberrancy in the general type, not from any desire to belittle the efforts of ingenious designers. I willingly admit that they show ingenuity of a certain kind, but I must add that it is misplaced. It is no particular advantage in the majority of cases for a steam engine to be capable of exerting a horse power in half the space usually occupied by such machines; there is "room and verge enough" in ninety-nine cases out of a hundred for all the power required for manufacturing. For marine purposes an exception may be taken to this statement, but it will be found, in almost all cases, that the claims made for compactness are wholly dissipated when the efficiency of each type is measured and the power developed is weighed in the balance. That is to say, the respective powers of the reciprocating engine and the freak engine are in no wise comparable, all other defects and disadvantages being ignored. One of the first announcements made on the advent of a new freak engine is that it has no dead center, no piston rod or cross head, no valve gearing, and requires no engineer, etc.; it might be added that it has no power, or not what it should have for the steam it demands. If this serious defect be ignored by equipping the vessel it is in with an abnormally large boiler, there is no buoyancy and neither passengers nor cargo can be carried. The whole procedure with freak engines is an effort to harmonize radical defects of design and principle with established facts and precedents, and after experimenters have spent all the funds they can beg or borrow, they begin to realize that they are on the wrong train.

In this direction, the wasting of money in futile experiments, I have seen some astonishing instances. It would be impolitic to mention specific cases of the character indicated, but a general reference to one which occurred but a few years ago is not improper. An inventor conceived the idea of a new steam engine which was to revolutionize the business (they never do less than this) and he proceeded to put his ideas into practical form. He was not a machinist, certainly not a mechanic. He overcame this difficulty by engaging assistants who had the necessary qualifications but were not experienced in steam engineering. The result of the combined talent of the staff was a machine quite unlike anything ever known before, and its very uniqueness and impossibility as a steam engine seemed to convince all concerned that they had made a great discovery. They were so certain of this that they went into the manufacture of the engine at once upon a large scale, without even demonstrating its practicability for any purpose whatever, the designer being able to command

a long purse—not his own, but that of another individual who had so much money that he did not know what to do with it. Large modern shops were constructed, and, as there were no tools known to the machine trade which would do the work upon the details, special machines that were useless for any other work were invented also. These tools were exceedingly large and heavy; being wholly new in character, all patterns and fixtures had to be made for them also. This expenditure, be it remarked, was undertaken prior to any knowledge of the possibilities or defects of the principle (if there was one) of the engine, and not one alone of one kind was made, but machines were designed for all possible uses likely to be encountered. I cannot, without giving a clue to this particular enterprise, describe these machines, but nothing more bizarre or absurd in the line of sane machine-designing was ever made before. I have had a tolerably wide experience in this direction in various parts of the country, and when I went through these shops I could not believe that any one connected with the enterprise—except the originator of it—had the least idea that the scheme was plausible, to say nothing of being practicable. I must add that not only were various kinds of machines designed, but several of each type were installed, and there they stood in long rows on the floor, melancholy instances of the fatuity of man when he once gets a wrong sheer.

When a general knowledge of this adventure was made known through the technical press the originator of it was kindly advised that his engine was a monstrosity of engineering and totally useless for the purpose he intended it, but these warnings did not deter him in the least from following his plans to the bitter end of total failure; just how many hundreds of thousands of dollars were spent upon this particular freak was not made public, since it was a private loss with which the public had no concern. It is not an isolated instance by any means, and not the least objectionable feature of such enterprises is the ruin of persons of small means who invest all their money in them when florid announcements of their great value are advertised all over the land, in just such exaggerations as the press dispatch here quoted from a late issue of a daily paper.

> "After working through several years of discouragement, success has at last come to the inventor of a certain device. He has received word from George W. Melville, chief engineer of the United States Navy, that it has been accepted by the United States Government and he has assurance that it will be put in use by European powers.
>
> "The machine was the winner of a competition authorized by the Government for oil burners that could be used to increase the speed of war vessels.

> Blank's apparatus claims superiority in the fact that it does not burn oil directly, but, by the infusion of steam and hot water, the oil is converted into a gas, which, while yet hot, is fed to the fire.
>
> "It is asserted that this increases the amount of heat ten times and it is said that battleships equipped with this burner may increase their speed by four or five knots per hour."

Readers of THE ENGINEERING MAGAZINE do not require to have the absurdities of this paragraph pointed out to them, but men who read the newspapers with a view to investing in schemes which will make them rich quickly too often act upon such wild statements. Just here is a remarkable feature of freak-engine enterprises—the avidity with which an impossible scheme is absorbed by financial confederates. A list of the promoters and stockholders, sometimes published, reveals the names of unknown individuals ostensibly backing and promoting it, but if these persons are looked up and demand is made for their personal knowledge of it, not one of them can or will say anything that has a bearing upon its actual commercial value, or soundness from an engineering point of view. They willingly assert that they "think" it is a good thing, especially the dummy stockholders who have been promised shares for the use of their names; but none of them can be held responsible for his statements.

Some years ago I was present at a visit of a prospective investor in one of these engineering fallacies, having strolled in to look at the thing from curiosity. The promoter was present in person, and the prosperous-looking investigator was at once pounced upon by him. He first pointed out the steam gauge, which showed a pressure of only 10 pounds, and said that the gentleman could see for himself that it was a very low-pressure engine; where other makers had to have ten times the pressure, his would run with far less and give out greater power. To demonstrate this assertion he took a piece of waste in his hand and bore down heavily upon the periphery of the flywheel. "You see" he said, effusively, to the gentleman, "that it does not check it in the least; just try it yourself," handing him the waste. The gentleman advanced timidly and gingerly touched the flywheel, much as if he was polishing a watch case, and said, after reflection: "Enormous power!"

"I am an engineer of long experience" said the promoter, "and wish to inform you of certain facts in the case which you cannot be aware of, but upon which much depends. The 10 pounds on the gauge gives us hundreds of pounds in the cylinder, the increase being obtained through this system of levers which you see here. These multiply the original pressure many times, but we have only to pay

for the 10 pounds of steam shown on the gauge. The levers also cause the main shaft to travel at twice the speed of revolutions (?) of the piston, so that we actually get twice as much power from the engine as others do. Now I will show you another test of the available power which any one can see for himself, without being an engineer." The promoter shut the globe-valve and the engine kept on spinning away for quite a while before it slacked up, then he turned triumphantly to the possible investor, who was greatly impressed. The promoter, however, carefully omitted to explain that the engine was not doing any work, and that it had an enormously heavy flywheel, so that it could not stop immediately if it had wanted to. What effect this jockeying had upon the investigator is unknown to me, but he disappeared into an inner office, the promoter following with alacrity.

Another curious feature of the freak-engine mania, with investors, is that they become ardent advocates of the scheme and serve to induce others of like ignorance to participate in the riches which are to to be made from it. They enjoin the greatest secrecy as to the existence of the engine, and seldom seek advice from persons who would be able to enlighten them. I have been approached by parties of the kind mentioned, but when I endeavored to learn something about the construction and plans of the engine and its inventor, so that I could form an opinion of its practicability, they refused to give any particulars, which, of course, ended the interview.

It has been stated in previous lines that the power developed by the freak engine is less than that of a standard reciprocating of the usual type, and this is readily seen when it is compared, engine for engine—that is, when equal piston areas and steam pressures are employed. For the sake of compactness, and from exigencies of the design, most of the freaks have very short piston strokes, say three or four inches, and by reason of this feature make a large number of piston strokes per minute; but even then the piston speed in feet per minute is very low. In the case of standard engines of small size, say 3 by 5 inches cylinder and piston stroke, running at 250 revolutions per minute, the piston speeds are, respectively, 125 feet per minute and 208 feet per minute, so that the freak must run nearly twice the speed of the standard engine for the same power nominal. It is claimed, however, by the advocates of such engines that this is a virtue instead of a defect, because they have some mechanism by which they gain power, usually levers, but sometimes cams, or their equivalent, and oftener than otherwise flywheels. If objection is made to this statement, the inventor wishes to argue the proposition

infinitely, but life is too short for this; when men are willing to be deceived and deluded it is a thankless task to try to convince them that machines give out less than is put into them, instead of more; for only the testimony of their bank accounts can convince them.

> "Dangerous conceits are, in their natures, poisons, which at the first are scarce found to distaste, but, with a little act upon the blood, burn like the mines of sulphur."

This well describes the freak-engine person; not even his depleted exchequer restrains his efforts to get something for nothing, unless, indeed, he is willing to learn by adversity. The number of these last is exceedingly small. It is the commonest thing to find, in looking over a new freak engine, that it varies but slightly from similar experiments made by Richard Roe half a century or more ago, and it would seem that so far from having any ideas of their own, inventors had ransacked ancient engineering records in endeavors to find something to improve upon by a trifling change of detail or port. They loom up very large upon the port question, and devise such intricate contraptions in this direction that it occurs to a cynical person that it would require steam of more than ordinary intelligence to find its way through them.

Invention is easy. A mechanic who knows what he needs can readily devise machines for any useful purpose, let it be what it may; but discovery—ah! that is another proposition entirely, and when men think they have made one in mechanics, or science either, for that matter, they should go into retreat for a considerable period, and chasten themselves. They need restraint. It is always the dream of mechanical enthusiasts that they may one day make a discovery, and it is doubtless this will-o'-the-wisp dancing before them which leads the freak-engine man to prosecute his endless quest. Sometimes, indeed, he has a measurable success. His engine actually works; it causes the flywheel to turn regularly, and to those who see only outward and visible manifestations it seems to be a step forward: but the supreme arbiter in all cases is the coal pile and the dynamometer; when the verdict of these two is rendered adversely there can be no appeal. The common fate of all the pretty motions and elaborate systems of ports is the scrap-heap.

> "To what base uses we may return, Horatio!. . . . Imperious Cæsar, dead and turn'd to clay, might stop a hole to keep the wind away."

Similarly, the cupola may render the *disjecta membra* of the once wonderful freak engine into vulgar pots and kettles for scullions to wreak their rage upon.

FOUNDRY MANAGEMENT IN THE NEW CENTURY.

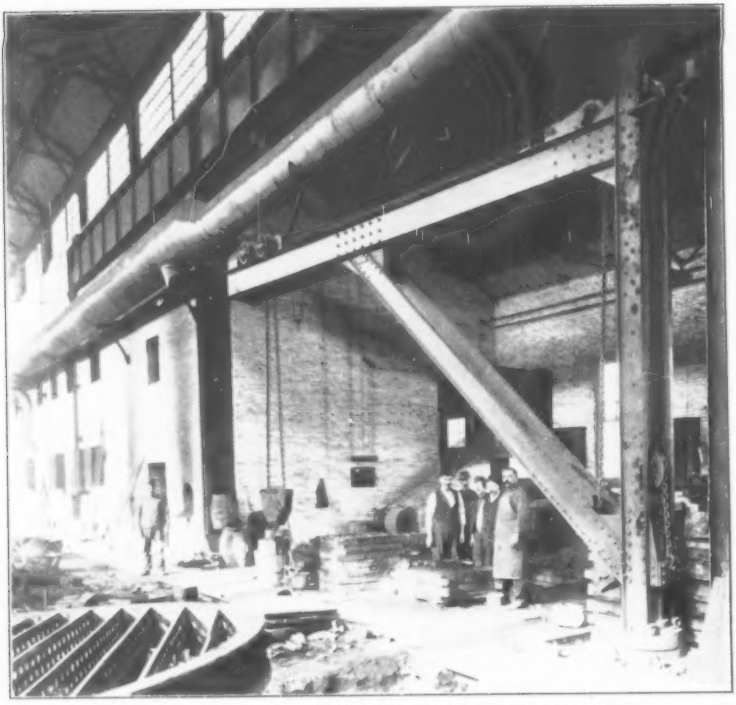
By Robert Buchanan.

II.—CRANE SERVICE FOR THE FOUNDRY FLOOR.

Mr. Buchanan's series began in our preceding number with an article on "The Economical Production of Castings," concerned chiefly with the general arrangement of the foundry, the question of heating and ventilation, and the supply of tools and minor plant. The present section takes up the crane service and the drying of cores and moulds. The next paper will deal with "Moulding by Hand and by Machine."—THE EDITORS.

OF all foundry appliances, the cupola alone excepted, cranes rank highest in importance. An ample crane service, as well as speed and nicety of movement, have an incalculable effect in producing the proper spirit and tone in which the work should be carried on. In short, if the cranes are slow, the pace will surely be slow; if fast, then the work can be and ought to be smartly produced. With bad or indifferent cranes and deficient crane service, bad results are certain.

I have already indicated that jib cranes occupying the middle of the foundry floor, whatever their services in the past may have been, are an anomaly and a hindrance in these times. There is one position in which a jib crane excels all others, and one only, and it does not come within the scope of these articles. Nothing can excel a jib crane placed at the raised centre of a circular pit in which pipes are cast on end; but in any other foundry and in any other circumstances jib-cranes are best relegated to a position away from the centre of the foundry floor and to a secondary position as auxiliaries to travelling cranes. In proof of this contention I need only mention the restricted sphere of action of the jib crane, the awkwardness and loss of time with which any ladles, moulding boxes, large cores, etc., are transferred from crane to crane, and the general dislocation of moulding operations which ensues when this is being done. As an auxiliary, the jib crane is in its proper sphere, and that a useful one. An arrangement of jib cranes which in practice has been found most serviceable, is one in which a crane is placed at each pillar, each crane having a radius greater than half the distance between it and the



HYDRAULIC JIB CRANE, WITH HAND TROLLEY TRAVERSE GEAR.

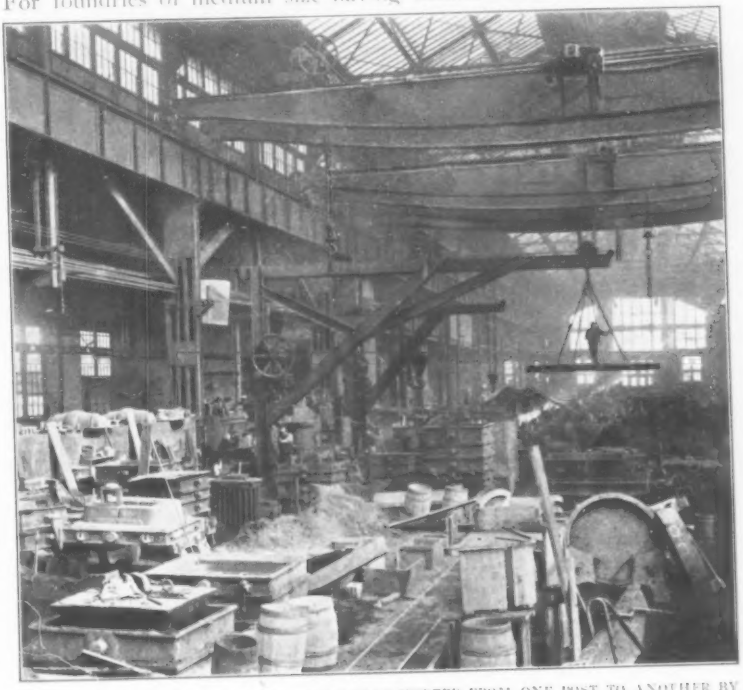
Jib is rigidly supported at fixed height and motion of the ram conveyed to the load by chains. Working pressures, 300 to 750 lbs. to sq. in. R. D. Wood & Co., Philadelphia.

next crane. In each pair of cranes one is higher than the other, so that when swung in line with the girders the point of one jib is under the other and both are out of the way of the travelling crane. Such an arrangement gives a good sweep of the floors and allows of the transfer of ladles, moulding boxes, etc., should the travelling cranes be so engaged as to render inconvenient their use for that purpose at the moment. However, the main function of these jib cranes is that of giving the numerous minor but important services which moulders so often require, leaving the heavy lifting and transport in general along the foundry, to the travelling cranes.

There should be a crane sweeping the space immediately in front of the drying stoves, for the purpose of loading onto the stove carriages the smaller class of loam and dry-sand moulds made there. This crane performs the necessary lifts for closing the moulds.

A jib crane or cranes should be at the service of each pit, whether making dry-sand or loam work. This gives the moulders engaged in heavy core work the unhampered and sole use of a crane for all purposes except the heaviest lifts. Thus the work can proceed unchecked by stoppages caused by lending the crane to others requiring its use, as often happens if a long bay be served only by a traveller.

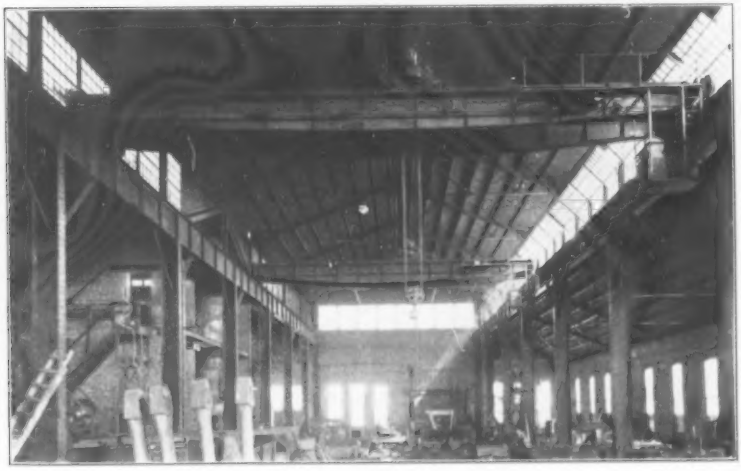
The kind of jib crane most suitable as an auxiliary will depend on the outfit in other directions. If there are dynamos for lighting and power purposes, then electric jib cranes will be the best. A few such cranes may be readily shifted from point to point as the work requires, connections being available at these positions. The facility with which such connections may be made gives the electric crane a certain advantage over the hydraulic crane, but neither type would pay unless as a user of power developed for other purposes as well. For foundries of medium size having neither electric nor hydraulic



PORTABLE ELECTRIC POST-CRANE BEING TRANSPORTED FROM ONE POST TO ANOTHER BY OVERHEAD CRANE.

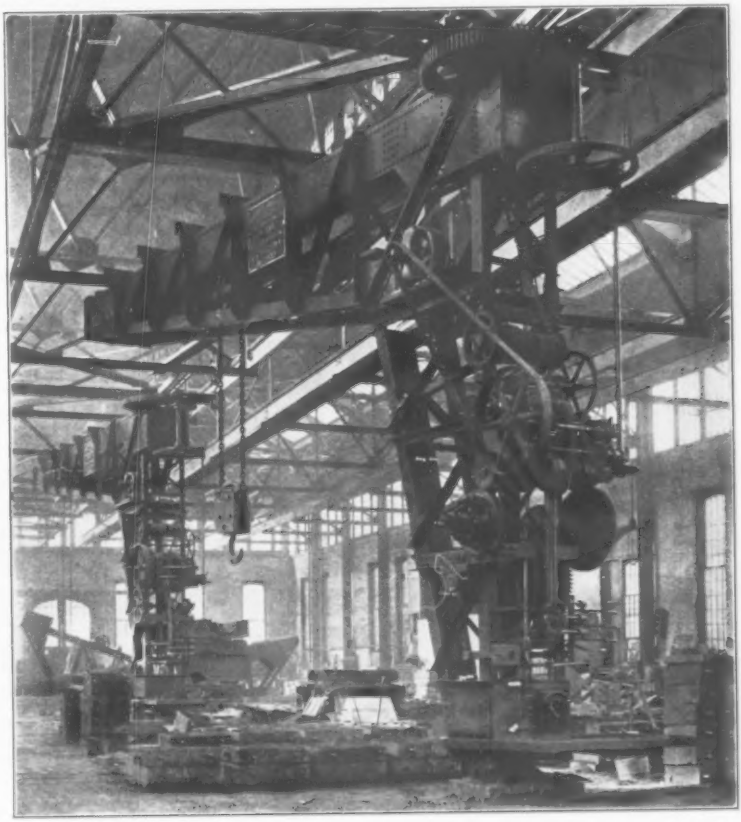
Foundry of the General Electric Company, Schenectady, N. Y.

CRANES IN THE FOUNDRY OF THE ALLIS-CHALMERS CO., WEST ALLIS, MICH.
In the foreground is a 60-ton Shaw electric crane with 15-ton auxiliary hoist and a span of 78 feet. The first three-motor crane built in the United States was designed by Mr. A. J. Shaw for the Milwaukee foundry of the Allis company in 1889, and was in continuous use for ten years.



FOUNDRY CRANE EQUIPMENT, BIRMINGHAM MACHINE & FOUNDRY CO., BIRMINGHAM, ALA.
One 10-ton crane and one 20-ton crane with 3-ton auxiliary hoist; Pawling & Harnischfeger, Milwaukee, Wis.

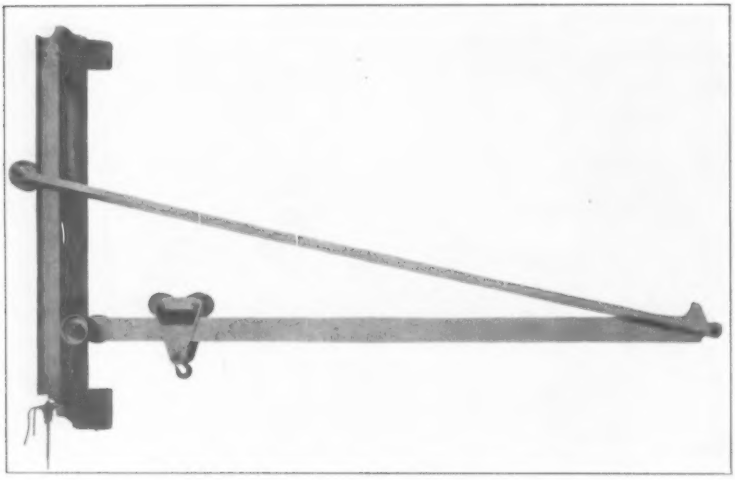
power, the jib crane with hand winch is much to be preferred to the smithy crane with overhead chain block one sometimes sees in a foundry. The smithy crane may be serviceable in a smithy; in a foundry it is only better than none, and that is the best which can be said for it.



10-TON ELECTRIC JIB-CRANE IN THE FOUNDRY OF THE BALDWIN LOCOMOTIVE WORKS, PHILADELPHIA.

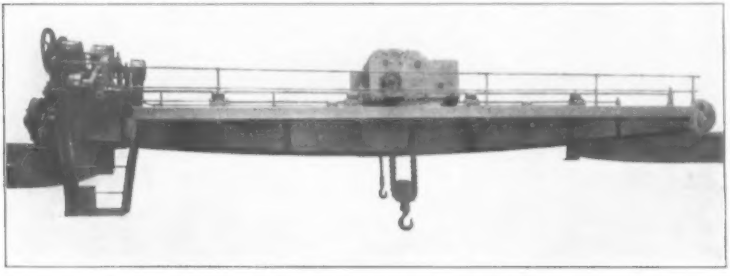
Effective radius of jib, 30 feet; has two hoisting speeds and lowers by power or brake as desired; constant-speed motor. Wm. Sellers & Co., Philadelphia, Pa.

Coming now to travelling cranes; the type most in use in Britain is that driven by a rope carried on pulleys, the power being transmitted to the winch or crab by means of a square shaft. A good deal of power is absorbed by the various pulleys carrying the rope, but I



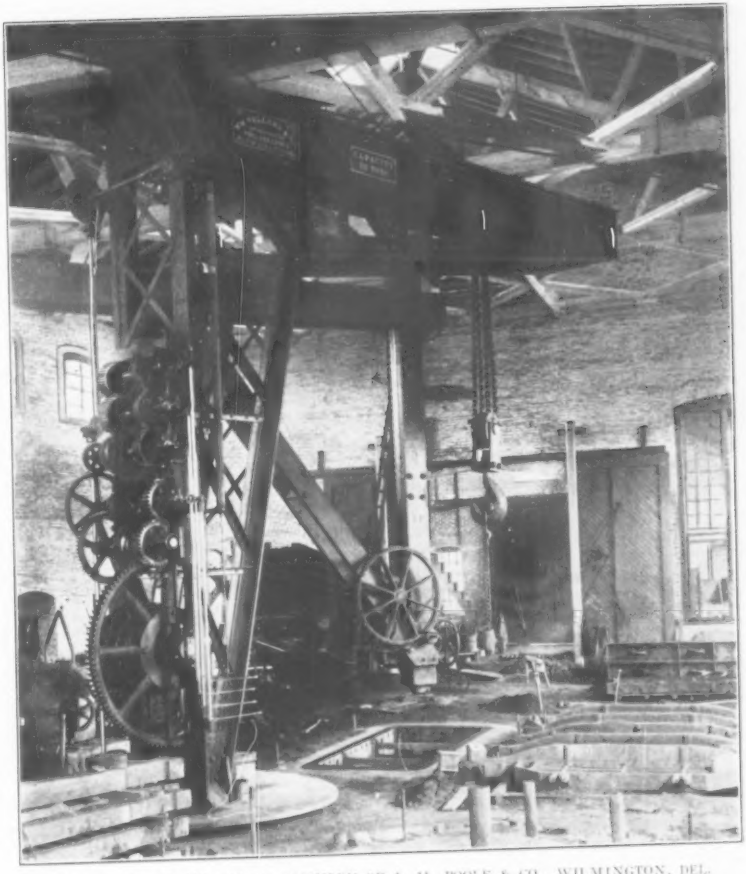
HYDRAULIC BRACKET CRANE. R. D. WOOD & CO., PHILADELPHIA.

take leave to doubt that it takes 5 to 6 horse power for every 100 feet of rope, as has been stated. If that were so, some of us would be in the evil case of having no power left over to do the work. When well made, the rope-driven crane is a very serviceable tool. Its principal weaknesses are these: Danger of the driving rope breaking, danger of the short belts on the crane breaking (one being a cross-belt), and danger of the slipping of the belt on the main drive should the lifts be very heavy. I have found it a good plan to have a spare rope ready spliced hanging along the girders, and this can be put into position and running resumed in a comparatively short time. To get the spliced rope on to the tightening pulley there is, of course, a



30-TON ROPE-DRIVEN OVERHEAD TRAVELLING CRANE FOR THE FOUNDRY.

Craven Bros., Ltd., Manchester.



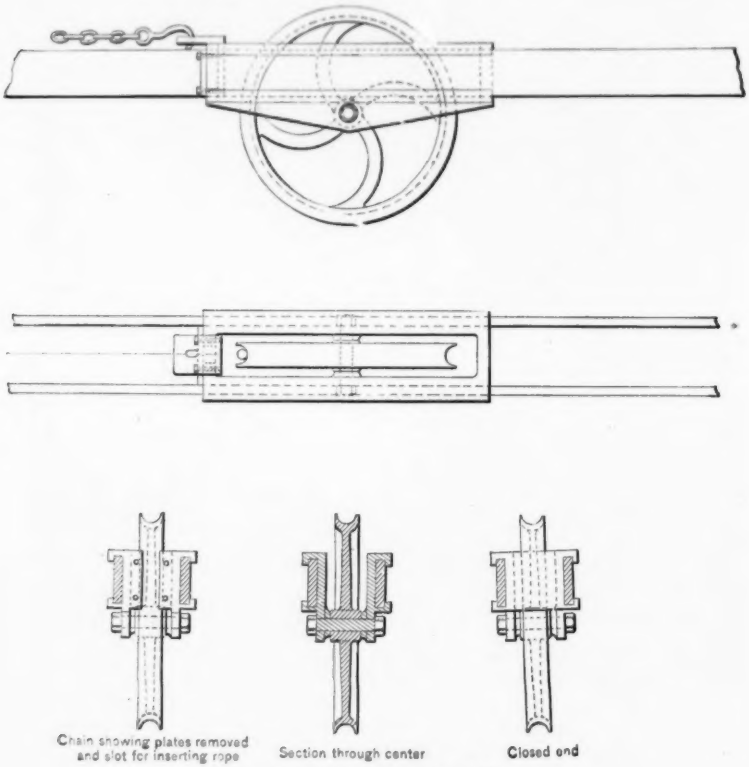
30-TON STEAM JIB CRANE, FOUNDRY OF J. M. POOLE & CO., WILMINGTON, DEL.

Height of post, 26 ft.; effective radius of hook, 23 ft. All movements by power. Driven by 8 by 8 engine, receiving steam through upper pintle and discharging through foundation plate. Wm. Sellers & Co., Philadelphia.

suitable opening in the carriage way with covering plate as shewn in the diagram on the next page.

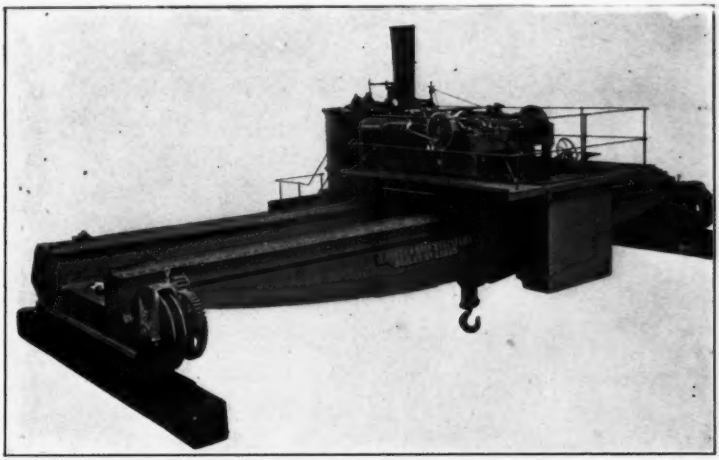
Having a spare rope ready to take the work as stated allows one to stop the use of the rope at work so soon as it shews signs of giving way, and so an actual breakage seldom takes place. If the rope does break it is usually when there is a large ladle of iron suspended from the crane, or some similarly awkward circumstance. It takes some thinking as to whether it is best to pour the metal into small ladles and so

cast what you can, and pour the remainder on the floor by means of the small ladles, or risk getting the rope running again before the metal sets in the large ladle. It is almost always wise to pour the metal out, and not run the risk of having a large block of solid iron of no use to anybody.



SELF-ADJUSTING CRANE-ROPE TAKE-UP.
Scale approximately 1/10 full size.

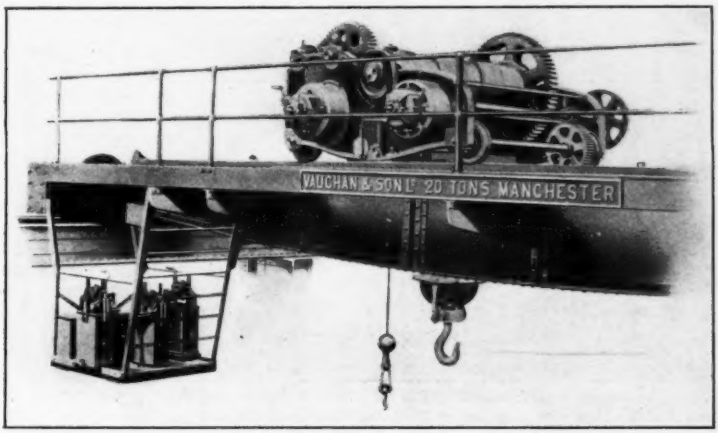
It should be seen that the wearing surfaces on foundry cranes are amply large, as otherwise the bearings soon wear down in the dusty atmosphere. Worms and worm wheels wear thin at point of contact, and if the square shaft gets out of line a serious vibration, especially with light loads, is set up. I have seen green-sand moulds shaken out by such vibration; the preventives are ample bearings and wearing surfaces, shafts in line, and the fullest possible exclusion of dust.



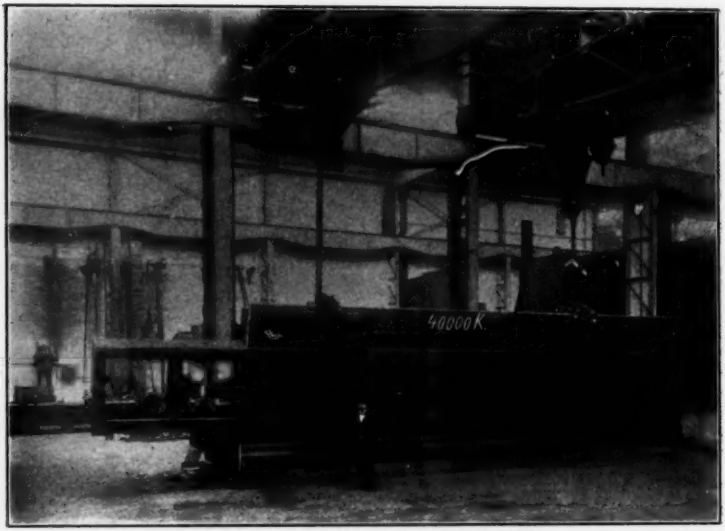
STEAM FOUNDRY CRANE FOR THE GREAT NORTHERN RAILWAY WORKS, DONCASTER.
By Joseph Booth & Bros., Ltd., Leeds, England.

One advantage of the rope-driven crane is, that it can be attended by a lad of 15 or 16 years. This considerably reduces the cost of attention, as in the case of belts breaking or anything else going wrong the engineman or general repairer sees to that.

Another useful type of travelling crane for foundry use is that which is steam-driven, as in the example shown on this page. This



20-TON FOUR-MOTOR ELECTRIC TRAVELLING FOUNDRY CRANE.
Vaughan & Sons, Ltd., Manchester.



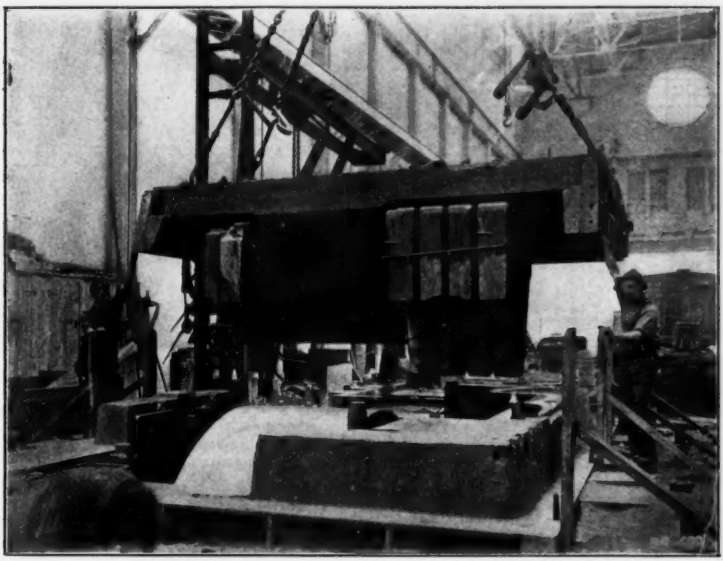
HEAVY CRANE SERVICE FOR THE FOUNDRY.

A large lathe bed in cleaning room, Deutsche Niles Werkzeugmaschinen Fabrik, Berlin.

THREE-MOTOR ELECTRIC CRANE OVER FOUNDRY CLEANING FLOOR.

Installed by Northern Engineering Works of Detroit in foundry of Braddock Mfg. and Foundry Co., Braddock, Pa. Illustrating modern practice in facilitating handling of castings in the cleaning room.

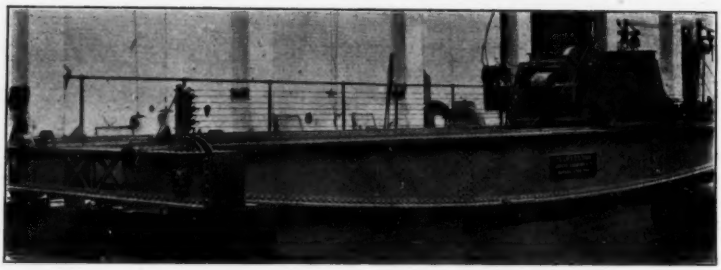
crane has excellent speed of travel, and a clever craneman will travel, hoist, and traverse simultaneously if required with the greatest facility. In this respect I should say it is difficult to surpass. It requires, however, a higher measure of personal skill in the craneman than is required in a rope-driven crane. In parting moulds, drawing patterns, or any similar operation involving nicety of movement, boiler pressure, quantity of steam admitted to the cylinders, and weight of load to be lifted all share in producing the lifting speed. In the cases



MOULDING AN ENGINE-BEDPLATE COPE WITH CORES HANGING, FOUNDRY OF THE WESTINGHOUSE MACHINE CO., EAST PITTSBURG, PA.

Suggestive of the nicety of crane movement necessary in foundry service.

mentioned the speed is desired to be, at the beginning at least, more felt than seen. If a craneman wants to get into trouble he has only to lift pattern or top part rapidly for the first inch and he at once attains his desire. Intelligence and experience, however, can get very satisfactory results with this crane, but the attendance has necessarily to be fairly well paid. As this crane is self-contained and independent of connection with any other motive power or gearing, the liability of stoppage, temporary or otherwise, is very little. One drawback it has is the necessity of getting water and fuel, usually



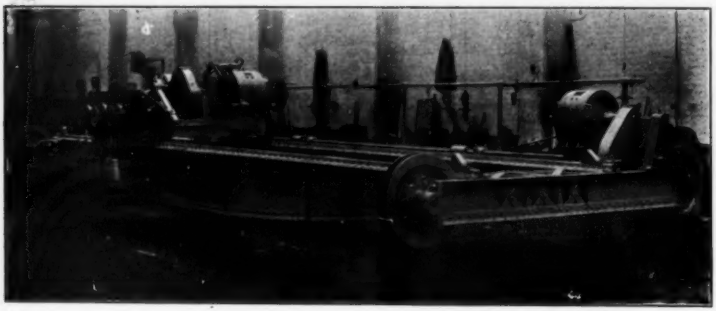
20-TON ELECTRIC FOUNDRY CRANE.

Enclosed first-motion gearing. Controlled from a cage travelling with the crane in the usual manner. Joseph Adamson & Co., Hyde, England.

gas coke, up to the boiler. This is done by having a supply of both fuel and water on the cupola platform or other suitable elevation. One other important thing has to be borne in mind, and that is the liability to fire by using a boiler near the roof. If the roof is constructed of iron with slate and glass as the covering materials, well and good; but wood is dangerous.

The use of electric cranes has extended greatly in the last five years, but British foundries at least, in marked distinction to American practice, have been slow to adopt them. Fear of the fine dust which floats about in the upper air of the foundry predisposes many to adhere to the rope-driven or steam traveller. With well fitting shields and covers the risk of trouble arising from the cause mentioned may be reduced to a very small point indeed.

The electric traveller is almost certain, in the not very far off



ELECTRIC CRANE TO LIFT 3 TONS.

Fitted with auxiliary hand-gear, and arranged to be controlled from the floor, if desired, thus saving the cost of a special attendant. Joseph Adamson & Co., Hyde, England.

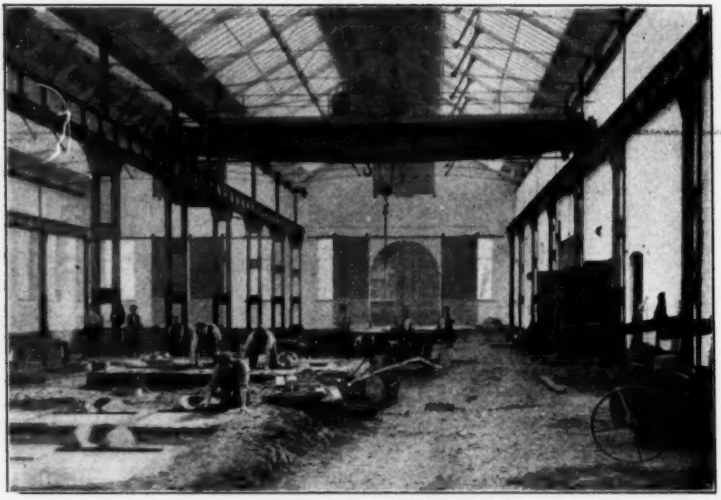
future, to supplant in great part all other types of travellers for use in large foundries. The craneman has perfect control of the hoisting and lowering speeds, and that, whatever the crane may be, is the greatest necessity of all. Travel may be had of any desired speed, and when not in use no power is being expended. This latter feature is a distinct advantage over the rope-driven crane, and in cleanliness and non-liability to cause fire the electric is superior to the steam traveller.

Deficient or inefficient crane service is a fruitful cause of loss of valuable time. I have known a dozen or more moulders to sit about for

30-TON THREE-MOTOR ELECTRICALLY DRIVEN OVERHEAD TRAVELLING CRANE.
Craven Bros., Ltd., Vauxhall Works, Manchester, England.

two hours or even a longer time waiting on crane service, and this is by no means an isolated case. It is useless to look for good results where such a state of matters obtains. The crane service is deficient if the moulder has to wait on the crane five minutes. It is inefficient if the moulder is caused extra work because of bad lifts or breakdowns in coreing or closing moulds. No effort or expense should be spared to make waiting on cranes unknown, and to reduce to a minimum the additional work given the moulder by reason of bad lifts, etc.

Stoves for Drying Cores.—For drying small cores all are familiar with the rectangular erection having a cast-iron plate on top (this plate usually being cracked) and a fireplace and fire under the plate on which the cores are placed to be dried. A great improvement on this is the core oven of the "Millett" type. It is more economical of fuel and dries the cores without burning them. Where gas is avail-



25-TON THREE-MOTOR TRAVELLING CRANE IN THE NEW FOUNDRY OF CRAVEN BROS., LTD., REDDISH, ENGLAND.

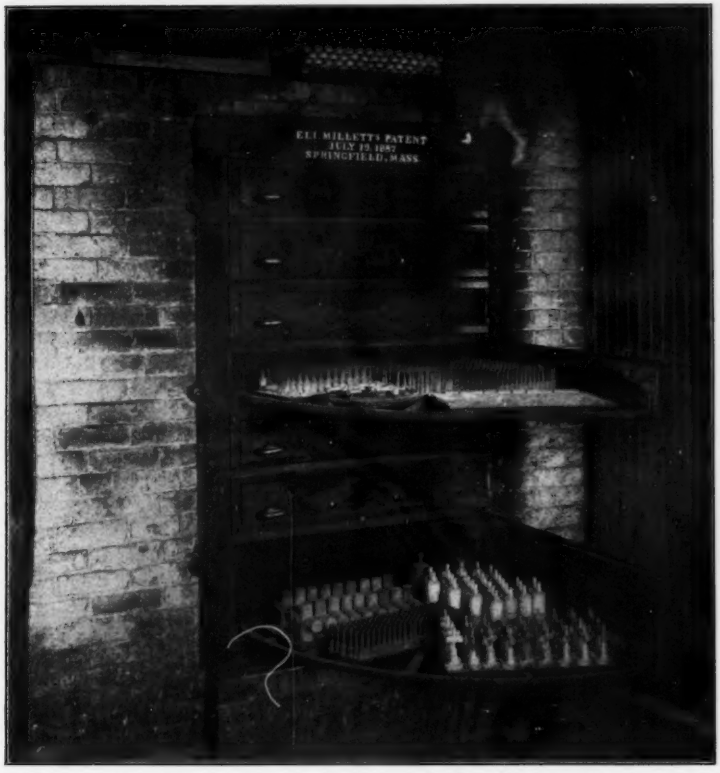
END OF BAY CONTAINING MOULDING MACHINES, FOUNDRY OF THE GENERAL ELECTRIC CO., SCHENECTADY, N. Y.

Showing chain-hoist and overhead trolley.

able as the heating agent this type of stove is difficult to excel for drying small cores.

The illustration shews the principal features of this stove.

Stoves for Drying Moulds.—Any change which has taken place in the last twenty-five years in stoves for drying moulds and large



MILLETT CORE OVEN, FOUNDRY OF THE STEBBINS MFG. CO., BRIGHTWOOD, MASS.

Shewing the manner of opening the swinging trays.

cores, has been in details only and not in the main features. These stoves are usually of a rectangular form and of a size suited to the moulds to be dried. They are fired from one end and the smoke from the fire and steam from the moulds are drawn from the stove by a flue placed near the floor at a point furthest from the fire. The flue is connected to a chimney, and in either flue or chimney there should

be a damper by which the draught may be regulated from the outside. The fire may thus be retarded, or if the fire is burnt down the heat may be retained, at will. Where stoves have to be entered while the fire is still burning, as is necessary in making loam cores, they should have in addition a top chimney going up through the foundry roof to the open air. Such a chimney need be of only moderate area, say 144 square inches, and should be closed by means of a damper which is

ELECTRIC CRANE INSTALLATION IN FOUNDRY OF MESS. W. H. ALLEN & CO., LTD., BEDFORD, ENGLAND.

opened only when entrance to the stove is about to be made. By this means the hideous wreaths of smoke which one sees so often when stove doors are opened are dissipated directly into the atmosphere, and not into the foundry first.

When moulds are heavy the carriage on which they are placed is made to run on rails, these rails having a slight inclination, or slope into the stove. This slope of rail need not exceed one inch in twenty feet and assists the getting of the carriage into the stove where the "pinch bar" applied to the wheels of the carriage is the means used.

If the pinch bar is the means by which the carriage with the moulds on it is got out of the stove, then the rails ought to be level. The slope into the stove is only of advantage if the carriage is drawn out by means of the crane or other application of power which can overcome the adverse grade without the expenditure of manual labour.

Where the smaller class of loam or dry-sand work is common, it is best to have no rails whatever and instead have the floor outside the stove and the floor of the stove itself plated with 1-inch plates which have been cast in open sand. A number of small carriages as shewn on page 532 serve as stands on which the loam moulds may be built,

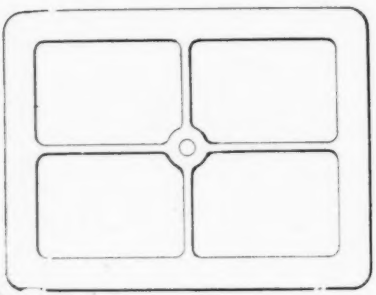
ELECTRIC CRANES IN THE CHILLED-ROLL FOUNDRY OF THE UNITED ENGINEERING AND FOUNDRY CO., VANDERGRIFT, PA.

In the foreground is a 20-ton crane with 3½-ton auxiliary hoist; the other two are 30-ton cranes with 5-ton auxiliaries; the span is 60 feet. Shaw Electric Crane Co., Muskegon, Mich.

run into the stove, dried, finished, and cast, in many cases without having to use a crane unless it be to close on the "cope" or top mould. Dry-sand moulds, of course, may be loaded on these and run into the stove, but whether it be loam or dry-sand moulds which are being made, if much coreing has to be done it is best to get the mould on to

the floor. The moulder is thus not troubled by the heat of the carriage and his work is at or under his level, not above it.

The means by which heavy moulds are got into and out of the drying stoves are few in number, and the most primitive of all is the most in use. I refer to the use of the pinch bar previously mentioned, which, as most people know, is applied to the wheels of the carriage; by means of a "heel" formed upon the pinch-bar a strong leverage is got. With a hot stove and hot carriage and moulds, getting out the carriage by the means mentioned is a work of the most trying nature. If a travelling crane is available, or a jib crane be in suitable position, then the carriage may be got out easily. In such a case it is well to have a sheave or pulley block fixed on the floor at a point beyond the rails at the end furthest from the stove. This obviates all risk of the crane tipping up a badly balanced carriage. A similar pulley block at the inner end of the stove may also serve to pull in the carriage by means of a wire rope led through the two blocks, if one end be attached to the crane mentioned and the other to the inner end of the carriage carrying the moulds.



An excellent method for getting stove carriages into and out of the stove is shewn in illustration of stove carriage in use by the Falkirk Iron Coy. One of the wheel axles is extended in length at one end. On this end is keyed a ring having recesses as on a capstan. Two capstan bars are

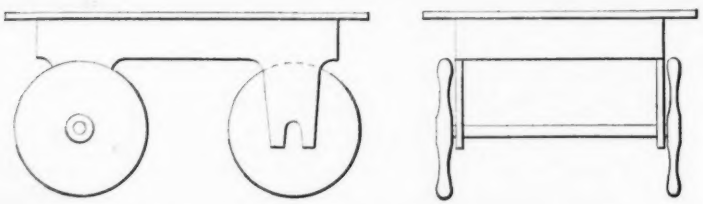
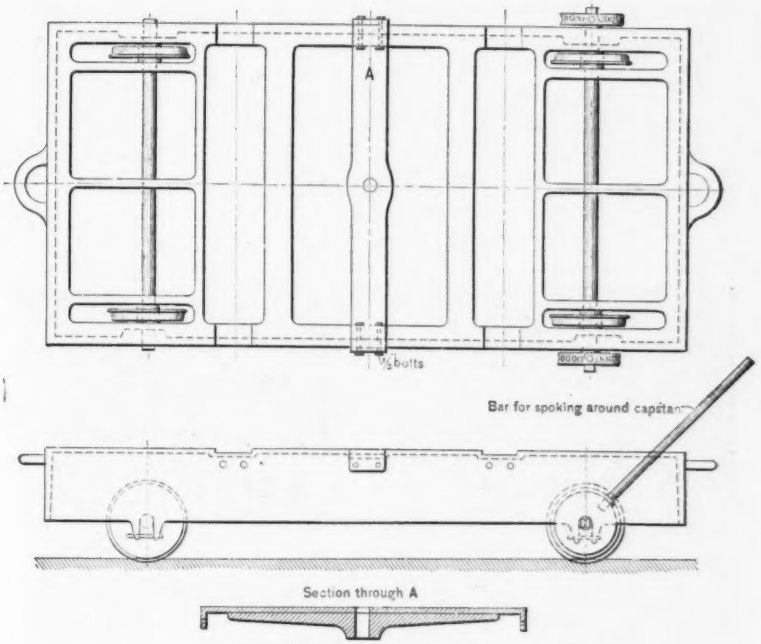


FIG. 6. STOVE CARRIAGE FOR SMALL LOAM AND DRY-SAND MOULDS.

3 feet by 4 feet, 2 feet high; thickness of metal about 1 inch; axle, 1¾ inch.



CORE-STOVE CARRIAGE.
Scale approximately 1/32 full size.

used, and by its means two men can move fairly quickly a carriage carrying 8 or 10 tons of moulds.

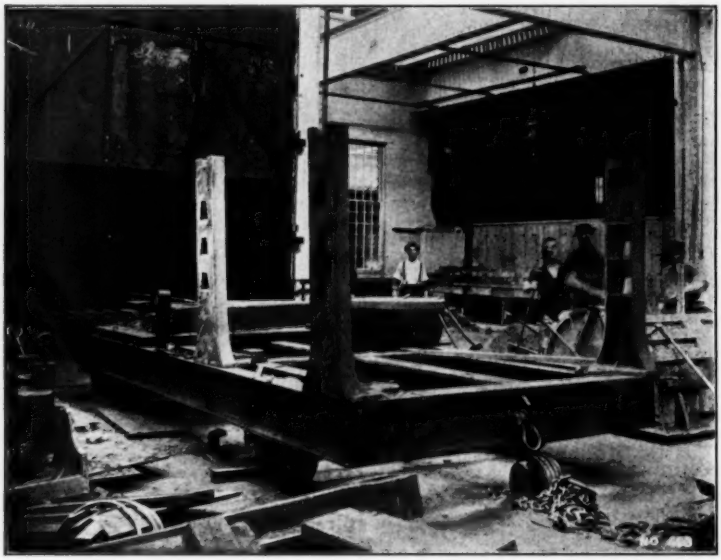
Capstans placed on the foundry floor and also cylinders using compressed air are occasionally used, and situated within the stove itself, but these are exceptions of a very rare character and are of the most limited application.

Stove doors are usually made to lift vertically and are made to do so easily by means of balance weights hung on the ends of chains passing over pulleys. This arrangement is quite satisfactory for most requirements, but I have seen an arrangement by which two stove doors of very large size are handled hydraulically.

Heating the Stoves.—For heating the stove the means most commonly used are rectangular fireplaces burning coal or gas coke. Sometimes the latter fuel is burned in "baskets" or "choffers" placed on the floor of the stove. This latter is a very indifferent and expensive method of drying the moulds. Coal is better than gas coke for rapid

working, but has the disadvantage of smoking the cores and moulds. The calorific value of coal is largely in excess of that of a similar quantity of gas coke and the coal requires a larger grate area for burning to best advantage. The fireplace for either coal or gas coke should be as near the floor as possible, and, where the exigencies of space will allow, ought to be wholly inside the stove, and be fired from the outside. Thus no heat is lost by radiation, unless it be through the walls and door of the stove.

Producer gas is sometimes used to dry the cores and moulds, but unless it be under certain favourable conditions its use is not economi-



CORE-OVEN TRUCK, WESTINGHOUSE MACHINE CO., EAST PITTSBURG, PA.

cal nor even altogether safe. Because gaseous fuel is a most excellent thing in a Siemens' furnace, it does not follow that it is the best fuel for a drying stove. It is certainly more cleanly than coal or other solid fuel, but it has distinct disadvantages. The foundry which possesses gas-fired stoves must have other uses for the gas made in the producers if gas is to compare favourably in cost with solid fuel. The stoves are used intermittently, but gas producers work most favourably when in constant operation. Besides, the gas from several gas producers will certainly be more regular in quality than the gas from one. One gas producer will make gas for several stoves, but should

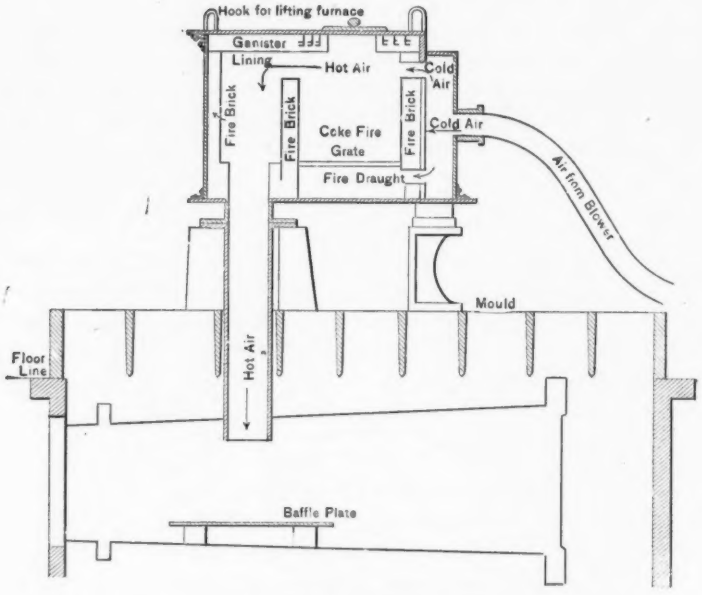
bad gas be made, that is, too great a proportion of carbonic acid, the gas in the stove will cease to burn and the carbonic acid and carbonic oxide—the latter a very poisonous gas—will fill the stove and spread along the foundry floors with rather alarming results to any who are there. The cost of gas producer, valves, piping, and attention will be more than that of any system of firing by solid fuel, unless, as already mentioned, the gas so used is obtained from a supply designed for a wide application of gaseous fuel. Under the latter conditions only may gas be profitably employed to dry moulds and cores.

Drying Moulds in the Floor.—When large dry-sand moulds have to be dried where they are made, being too large for any stove to take in, or by reason of the mode of moulding adopted leaving that as the only course to follow, a good system of drying becomes a most important matter. The drying is done in most cases by forming trenches outside the mould, these trenches being filled with coal.* The whole is covered with sheet-iron plates when the coal has got well alight. No attempt is made to provide air for the proper burning of the coal, and so the foundry is constantly full of a most irritating smoke, provocative of headaches, watery eyes, and bad language. A foundry with three or more pits constantly fired by such means is a most excellent place to keep away from. Such an abomination was allowable when no other way was known, but now that a better, cleaner, and cheaper system is available, foundrymen ought to see to it that the smoke-laden atmosphere due to the firing of pits is gone, never to return.

Drying Moulds by Hot Air.—This system, introduced some years ago, was adopted by several progressive foundries and it is to be hoped will, in the near future, supersede in great part the use of coal for drying moulds in pits or on the floor. The illustrations which appear on the next page shew how the system is applied and render unnecessary any extended explanation. Flexible pipes connected to a blast main convey air to a portable furnace of which gas coke is the fuel. The portable furnace is placed over the dry-sand monid as shewn, with the result that a copious stream of hot air and the products of combustion completely fill the mould, with most satisfactory effects as regards drying and with an absence of smoke, ash, and dirt. If the mould be shallow the hot air may be "baffled" as shewn on page 536 and burning of the mould thus be avoided.

As only a fine dust is present in the mould, this is quickly brushed

* Fire-lamps, that is iron baskets containing coal or gas-coke are also often hung inside the mould to assist the drying.



DRYING IN PITS WITH HOT AIR.

off and coreing is proceeded with in a very short space of time. Drying by hot air proceeds from the face of the mould downward and outward and is very equal in its effect on all parts of the mould. Drying by fires in trenches round the mould proceeds from the outside inwards and the bottom of the mould, which has often the weight of cores to carry and "scabs" the most readily, is least dried of all. A hot-air-dried mould dries from the face inwards for only a few inches and so requires smart handling in coreing, closing, and casting, so that the damp does not get to the face before getting the metal in. Every dry-sand and loam mould should be cast while still warm and so a good arrangement for handling cores and moulds is a necessity for the best and most profitable use of this very important advance in recent foundry practice. The way the mould is got ready for hot-air drying is as follows: The joint is sprinkled with parting sand and the top tried on. If there are no "crushes" the top is carried up on "sconces" or supports which cause the top part to rest one inch or so above the mould. The hot air is turned on and when the greater part of the steam has been expelled, the opening round the mould is

closed by means of loam and the heat is kept in. Moulds to take 14 to 16 tons of metal are thus successfully dried.

Skin Drying of Green-Sand Moulds.—The skin drying of green-sand moulds is essentially the drying off of water which has been put on to the mould to fix the blacking on the face more effectively than simple "sleeking" with tools will do. Skin drying is used extensively in the United States and less commonly in Great Britain. It may be used in many cases as a good substitute for the smaller class of dry-sand moulds, as it gives a skin to the casting little inferior to that of dry-sand coated with blacking having claywash as the fixing medium. A green-sand mould which is subject to much pressure of metal may be helped to withstand such pressure without "swelling" by means of skin drying.

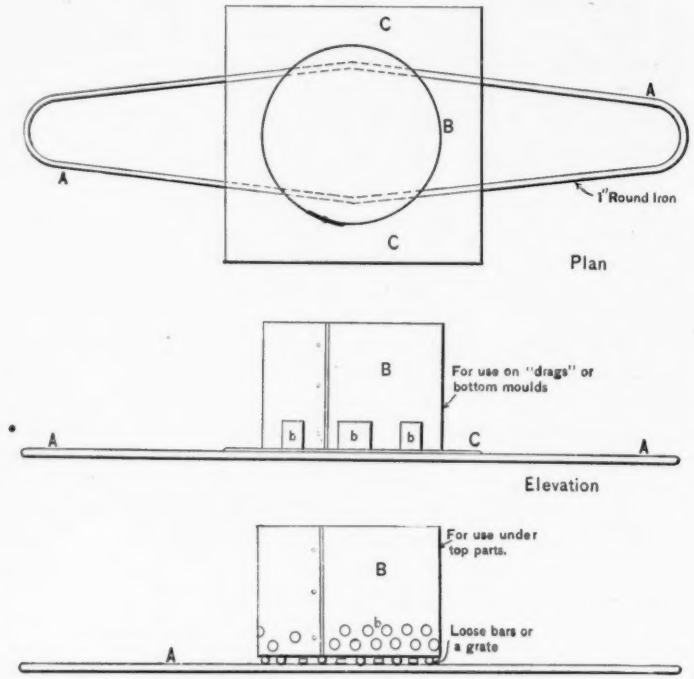
Green-sand moulds intended to be skin dried are made in the same way in every respect as for ordinary green-sand work, care being taken that the sand is not so damp as for dry-sand work. When the mould is finished, blacked with the bag and the blacking sleeked or smoothed with the tools, the surface is brushed over with water by means of a fine camel's-hair brush. A still better skin is obtained if some good plumbago or "black lead" be mixed in the water, or, as some recommend, boiled in the water. The mould must not be sleeked after the water is applied. In cases where the pattern leaves perfectly and sleeking of dry blacking would readily distort the lines, the flutings of a column for instance, then by means of a swab made of the finest quality of hemp, a mixture of charcoal blacking and plumbago in water may be applied with excellent results by one skilled in the use of the swab.

There are several means adopted to effect the skin drying. The crudest is that of casting a slab of metal and suspending it over the mould. Better than that, but with an element of danger, is pouring on naphtha or kerosene and setting a light to it. Another plan is to put the mould in the stove for 1½ to 2 hours if the mould is wholly in a "turn-over" box.

The illustrations on page 538 shew the best plan of all. For "drags" or bottom moulds the bottom of the fire pan is a plate with no perforations, and stick charcoal is the best fuel to use as it has little ash to hinder conduction of heat through the plate. If a crane is available the top part may be dried over the same fuel. If the crane is not available, then the top part, resting on stands, has the fire pan underneath. Fire pans for drying top parts have bars to carry the fire and in these gas coke may be used.

The advantageous use of skin drying has its limits. Where heavy cores have to be carried up on "chaplets" it will often be found preferable to make the mould in dry sand.

Cores.—The binding materials used in core making are legion; clay, dextrine or "gum," resin, flour, linseed oil, are some of the principal.



FIRE LAMPS FOR SKIN DRYING OF MOULDS.

A, wrought-iron bearer; C, iron plate 1/8 or 3/16 inch thick; B, sheet-iron cylinder; b, b, draught holes. All the parts are loose and inexpensive. The plate C is used in drag drying to keep cinders from falling into the mould.

Clay made into a wash of the consistency of thick cream is in universal use for making core sand suitable for large cores. If the cores are to skin or peel nicely, then a coating of black wash, preferably mineral blacking and clay water, is a necessity. When cores made of clay wash and sand with little or no coal dust or other carbon in it are used unblacked, the holes made by the cores are rough. This is due to the clay and sand forming a compound which fuses when the metal

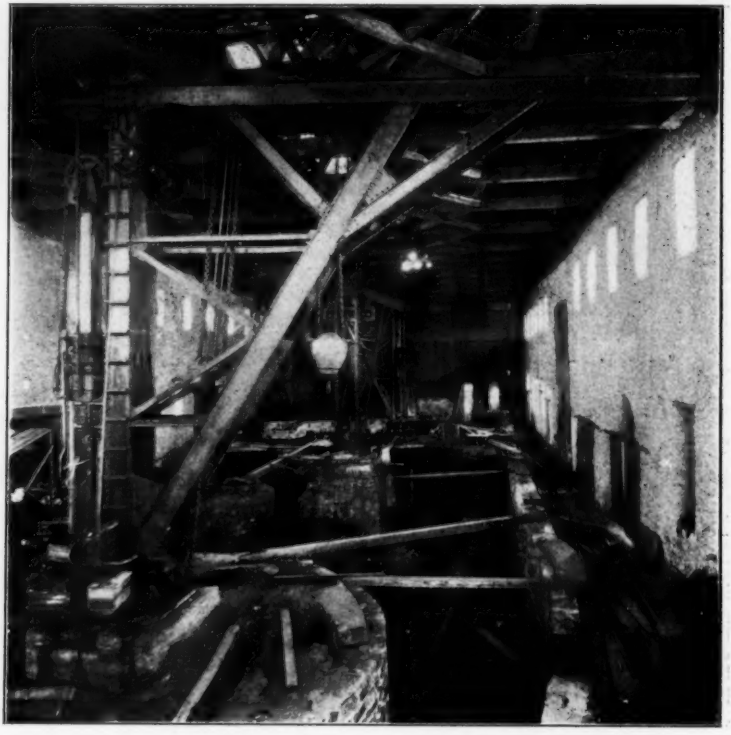
THE EAST BAY OF THE ALLIS-CHALMERS COMPANY'S WEST ALLIS FOUNDRY.
Showing general construction, lighting, and crane arrangement.

flows round the core, and forms the rough skin so much disliked by engineers, as it rapidly blunts the tools. If the cores are not required to leave a very smooth skin, then an addition of coal dust to the core, sand, or sand rich in carbon taken from the moulders doing light work, will save the work of black washing.

Where a large number of cores are used, sizes small to medium, core sand prepared as follows is difficult to beat.

1 barrow load burnt sand from the castings.
5 do do sand from the moulding floor.
1¾ pounds of dextrine or "gum" to each 3 hundred-weight of sand.

This mixture is damped and riddled and is ready for use. It dries into a core so hard as to be rubbed or "carded" with difficulty. Though



COMBINED HYDRAULIC AND POWER JIB CRANE.

Trolley and swing motions operated by gearing and clutches from belt-driven shaft or electric motor, hoisting by hydraulic power. Shown installed on a raised center of a casting pit. R. D. Wood & Co., Philadelphia.

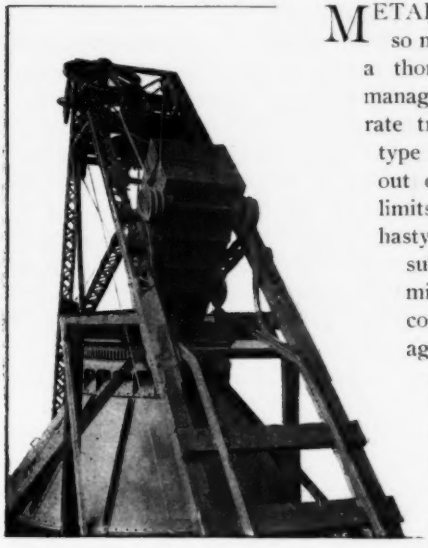
hard, the metal lies quietly on it unless too much gum be in the mixture. Some moulders keep a card for rubbing cores as part of their outfit and they use it on all and every occasion. The carding of cores may be a necessity now and again, as helping misfitting cores out of a difficulty, but in repeat work such botch work should be rectified.

The core maker by making his core sand of the proper sort can help to cheapen considerably the work in the dressing shop. The mixture given consists of practically pure silica. Silica is infusible and without bond. The gum supplies what the sand wants, but being volatile burns off when the metal surrounds the core, with the result that the cores simply drop out in the dressing shop.

THE MANAGEMENT OF METALLIFEROUS MINES.

By Albert Williams, Jr.

In the following paper Mr. Williams takes up the management of metal mines as contrasted with that of collieries, so well discussed by Mr. Blackmore in THE ENGINEERING MAGAZINE for July and August, 1901, and purposely avoids repetition of points common to both fields. This first paper reviews briefly the widely differing kinds of metal mining, and offers suggestions as to a general line of policy applicable to the majority of cases. In a second article systems of organization will be compared, the relations between the business and technical ends defined, and the needed qualifications of superintendents and managers set forth. A third and concluding article will take up in detail the efficient organization of the technical staff.—THE EDITORS.



METALLIFEROUS mines differ so much among themselves that a thorough discussion of their management would involve separate treatment of each of many type groups, which is obviously out of the question within the limits of a single paper. Only a hasty glance at this phase of the subject is therefore here admissible. When we think of a colliery, a fairly distinct image is mentally formed; whatever minor variations exist, the mineral is substantially the same, the methods of finding the coal, of mining it, and of handling the product, have a family resemblance, and (what is more to the point) the establishment is always of considerable, often of very large, magnitude in order to be profitable—which means that a large force has to be directed and usually a heavy hoisting, pumping, and other plant to be operated. No such general conception of a metal mine is possible. Its product may be one or more of a wide range of minerals occurring in entirely different conditions, involving special methods of prospecting, mining, and subsequent treat-

ment; the scale of operations may be anywhere between a coyote hole and a great low-grade mine employing hundreds of men; it may be a surface or a tunnel mine with little or no machinery, or it may be equipped with machinery capable of hoisting and pumping from a depth of 4,000 feet or more, to say nothing of the other highly specialized plant for treatment of the product. Furthermore, the commercial risks and the dangers to life and property are not the same in metal mines as in collieries. For example, the ventilation problem is a very minor one in the former class, while of prime importance in the latter.

The bearing of this is obvious. An anthracite-mine superintendent would soon feel at home in a Puget Sound soft-coal mine; so too would a North-of-England colliery manager. But one specially versed only in quicksilver mining would be rather lost in a big Lake Superior iron mine. Hence it is that there has been a gradual differentiation of mine managers, just as there is in the expert staff. A certain broadness of character and experience is most desirable; but it is well for young engineers to elect at an early stage which line of mining they intend to devote themselves to, and if well advised, the employers are largely guided in their selection of a superintendent by the latter's aptitude and previous experience in the particular branch of mining projected.

In considering the functions of a superintendent, then, it is necessary to note first the kind of mine he is to manage. The deposit is unchangeable, but there is a choice as to the man. Now the field may be looker at from several viewpoints:

To begin, as to the size and importance of the undertaking. If the mine is a very small one, a mere prospect perhaps, the owner often acts as his own superintendent—that is, if he is anything of a miner; if not, he hires some one familiar with the work in hand, preferably a practical miner used to the district. It would of course be foolish to employ a highly salaried superintendent to boss a single day-shift of two to half-a-dozen men. At the same time, there is plenty of room for skill and judgment in these small beginnings, and there are some precious-metal mines of "specimen" ore where there is working space for very few men to stope, but where the closest attention is required. A different case is presented when the small operations are possibly preliminary to important undertakings, as in prospecting known ore-bearing ground (by pits, tunnels, or diamond drill), with a view to determining the best mode of systematic attack; here the highest available acumen is demanded from the outset.

Perhaps the most exacting sort of mine to manage is one of medium size employing a crew of say twenty to fifty hands, which will not stand the expense of an expert staff. Such a mine ought to have, but cannot afford, specialists in all departments; yet the superintendent may consider himself lucky if he has one good underground foreman. He here finds his resources severely taxed, for he may have to combine in himself the functions of manager, assayer, surveyor, accountant and clerk, mill-man—and miner, of course—besides being occassionally called upon to lay out a surface road or a ditch, design a bunk house or mule shed, or install a plant. One eminent expert prided himself on having put up a roasting furnace mostly with his own hands, as there was nobody in the camp who knew how to set fire-bricks. The men did not call him "professor" after that.

The superintendent of a small or medium mine must always stand ready to take off his coat to tackle any odd job for which no one else is readily available; but it is a mistake to suppose that ability to strike an upper, or sharpen a drill, or put in a timber set, is more than an interesting though superfluous accomplishment under normal conditions, though he should know when these things are properly done. What is here said about the size of mine must naturally be modified according to its other characteristics. It may be a very simple proposition which a reliable former foreman could safely handle, or it might present very perplexing problems and involve multifarious operations calling for all-round technical skill.

In some respects a big mine—the bigness consisting in either the number of hands, the value of the product, or the scale and diversity of operations—is easier to run than one of the class just considered. The paradox is readily explicable. It is because the manager of a great mine is relieved of many details by his staff, and can devote his attention mainly to the larger questions of policy both as regards the mine itself and the business aspects of the enterprise. With competent assistants, it is not absolutely necessary that the manager himself should know how to do many of the things which they do for him; indeed, if he selects them judiciously, each should understand his own specialty better than the manager himself does. Certainly the superintendent cannot know too much; but that he cannot "know it all" goes without saying. What is here wanted is the man of affairs, not the specialist; if he has a fair general technical training, enough at least to supervise and gauge the work of his immediate subordinates justly, so much the better. And he should have a clear idea of a day's work of any sort.

Next as to the character of the mineral and its mode of occurrence. Various classifications have been given from the geological standpoint, but for the present purpose of illustrating the managerial requirements it is necessary only to group the mines very roughly and arbitrarily, taking into account the peculiarities of occurrence as they affect the methods of prospecting, exploiting, and disposal of product.

Placer deposits of gold and (rarely) other metals, such as platinum, form a class by themselves. It is only in the largest undertakings of this sort that the question of superintendence is of much moment. At some of the great hydraulic mines, now mostly extinct, however, a very high degree of professional ability has been shown, both in the direction of originality and daring and of extreme economy. (The record is 2.9 cents per cubic yard to cover expenses). This has involved the preliminary expenditure of large capital, good civil engineering, and a knowledge of hydrostatic and hdyraulics; but the management of the men, so few being employed, has been simple enough. Small workings, like ground sluicing, beach mining, etc., do not call for any special superintendence; and to run a gold dredger is much like the job of a contractor on harbor improvements.

Stream tin presents no special features and need not be here considered.

Other surface workings (apart from the "stripping" iron-ore mines of Minnesota and Alabama) are usually on the outcrops of veins and beds which are later mined underground. In their earlier development the work is simple, like quarrying, and generally on a small scale, though there have been exceptions such as the heavy gold-bearing outcrops of the Black Hills and Alaska where the managers had ample scope for their talent.

Veins of free gold, or mixed ores carrying free gold associated with sulphides or tellurides, and strictly refractory gold ores, form a pretty closely related group, the exploring and exploiting of which are conducted on well-understood principles; but on the metallurgical side important differences exist requiring special aptitude on the part of the manager, unless he relies on others.

"Straight" silver mines, that is, mines producing ores carrying silver as the only valuable content, are found in comparatively few localities, but some have been very productive (Aspen and some Mexican and South American districts, for example). Silver mines in which gold is an important item are more common. Both of these classes present very intricate problems to the mine manager, who should understand at least the outlines of economic geology and have

a diversified experience—and even then will usually have to do much guessing and boring to locate an ore body. The treatment of these ores is also often a puzzle. It may be noted in passing that "free" silver mines (whose ore is worked raw by pan amalgamation) are practically obsolete, better metallurgical practice having changed their appellation and the methods of ore treatment.

Most of the silver and a noteworthy proportion of the gold now comes from base-metal mines and might be termed by-products, the mines being operated just as if these were merely lead or copper deposits (as the case may be). Hence are found two other classes of mines and two other sets of specialists. One group of mines comprises the lead-silver and the lead-silver-gold, and the other the copper-silver, copper-gold, and copper-silver-gold deposits.

Lead mines of another type include those whose ores do not carry enough silver or gold to be helped out financially by the value of these by-products, and in working them the manager has to keep in view economy rather than style. Lead ores are often associated with zinc or antimony ores; here a knowledge of the methods and appliances of concentration is required, and as these mines are generally small the superintendent has to run his concentration plant without expert assistance. Zinc mines proper come under the same head.

For large-scale of working and close economies there are few examples to be compared with the Michigan and Montana copper mines, which in this respect rival the iron and low-grade gold mines. As a rule, small copper deposits are not capable of profitable working, so that the bulk of the copper output comes from a comparatively few very heavy producers. The ores being usually low-grade (less than one-half of one per cent, or under ten pounds of metal per ton of ore at the record mine having been profitably worked, while five per cent. and upward is thought high-grade), a large and fairly regular ore body, permitting a steady supply, is essential; and this implies a numerous force, much machinery, and large quantities of supplies. The need of administrative ability is therefore imperative, and in the Lake district the custom has grown up of virtually separating the business from the technical functions, the "agent" relying upon the "mine captain" for the direction of the underground work and upon mill and smelter superintendents for the metallurgical part.

Somewhat similar, as to the manager's duties, are the iron mines. Under existing conditions small deposits of iron ore are commercially unworkable. It is only by handling a very heavy output that the small margin of profit per unit of bulk is made to count. A large

part of the wonderfully close economy in getting the ore from the mine to the usually far-distant furnace (as was shown by Mr. James N. Hatch in THE ENGINEERING MAGAZINE for August, 1901) is due to ingenious ore-handling machinery and means of transit, but at the mines themselves a like progress has been made. At these mines mechanical engineering has full scope, while the business feature is naturally much in evidence. Manganese mining resembles iron mining, but the scale is smaller.

Quicksilver mining is a specialty requiring much local experience, and the successful superintendents have mostly been promoted from the skilled force at the several mines.

Mines of other metals than those mentioned are small and exceptional and do not demand special notice in this connection.

Another way of looking at the matter, in estimating the requirements of superintendents, is to consider whether the operations are purely or mainly those of mining, or are complicated by the addition of reduction plant belonging to the mine, located at or near it, and under a single head. What has just been said as to the character of the ore will in a measure indicate how a fresh classification of mines can be drawn. A free-gold mine almost always has its own mill; other gold mines are equipped with cyaniding, chlorinating, or concentration plant. Silver mines proper have their own mills or use custom mills in the neighborhood, or more commonly ship the product to lead-smelting works. Lead and lead-silver mines nowadays nearly always ship their ore to a central smelting center, to works operated under separate ownership, since the railroads have been pushed to almost all productive districts; sometimes they have concentrators on the spot. The ore shipped is sold outright on sample. The large copper mines have their own reduction plant at a convenient location within a reasonable railroad hauling distance and under the same general management.

The tendency in the United States has drifted constantly toward separating the mining from the reduction works, it having been found often cheaper to transport the ore even a long way (hundreds of miles in some cases) to points where it can be worked to best advantage, thus saving first cost of reduction plant to the mining company. This policy has to a large extent relieved the mine superintendent from the necessity of supervising the metallurgical work, it being possible in the case of many precious-metal, nearly all lead-silver, and practically all plain lead and zinc mines, to dispose of the product by shipping as run-of-mine, or after hand sorting or with a concentration treatment

at the mines which does not make large demands upon the manager's attention. In the case of iron mines, even when owned by the iron and steel companies which turn out the finished product, the mine superintendent is always free from responsibility as to the smelters.

Still another factor is the location of a mine. If isolated, far from supplies, means of repair, local skilled labor, and with poor transportation facilities, the manager will often be left to his own resources and to save time must be ready with expedients in emergencies. If his field of duty is in a Spanish-speaking country he should know or acquire that language, if only in an imperfect manner.

It also makes a difference in the duties of a superintendent whether his mine is one employing little or no machinery, or has much of it. There are few large mines of the former class, for even surface mines may have extensive drilling or steam-shoveling and loading plant, while tunnel mines of any considerable extent are equipped with drilling, haulage, ventilating, and lighting appliances. To these the deep (shaft or incline) mines add the hoisting and pumping outfit, often very heavy. It would be desirable therefore for the superintendent of a mine equipped with much machinery to have at least a smattering of mechanical engineering, including the electrical, pneumatic, and hydraulic branches. Two very successful managers, it is recalled, were prominent mechanical engineers with no previous mining experience, who of course availed themselves of good mining and metallurgical assistance. Still, without this mechanical ability, the manager of such a mine might turn over the details of that department (giving it due prominence) to a specialist, reserving only a general control and supervision. The practice in the United States and in other countries supplied by American machine shops is for the latter to send out with the machinery, if of much extent, a man or a gang of men to install it and make sure that it is in running order. The shops regularly employ specialists for this purpose, and many send one to set boilers, another to line up shafting, others for placing special motors and machines, an electrician to arrange the wiring, and so on. Thus in the original installation the responsibility falls mainly on the contractors. But even before the selection of plant the superintendent may have the services of an independent consulting engineer; while the leading shops, for their own reputations' sake, give full information and advice which is generally reliable.

THE EFFECTS OF WIND PRESSURE ON STRUCTURES.

By Robert M. Neilson.

As Mr. Neilson himself indicates in his opening paragraph, he is considering the subject of wind pressure on engineering constructions under conditions existing or to be expected in the British Isles. The fact, however, that his discussion is concerned with the general phenomena of wind motion and with the methods of investigation and deduction of formulæ, rather than with the determination of any absolute factors, gives the paper wide application. It is a comprehensive review of the best work that has been done in the field and a clear statement of some not very generally known facts.—The Editors.

IT was the Tay Bridge disaster of 1879, more than anything else, that caused engineers in Great Britain to consider the effect of wind pressure on bridges and other structures. Previous to that event the consideration given to the subject was of a comparatively trifling nature. In fact, about the time of the introduction of iron-girder bridges it was thought by many that, if a bridge were strong enough to carry its own weight and its travelling load, it would be absurd to suppose that any wind pressure could rupture or overturn it. No attempt was therefore made in many cases to estimate the stresses caused by wind pressure or to provide for them in the design of the structure. Of course, it should be borne in mind that for the same factors of safety metal bridges were considerably heavier then than they are now.

After the Tay Bridge disaster, a committee was appointed by the Board of Trade to advise what provision should be made in future with regard to wind pressure. With the scanty data available at the time it is not surprising that some of the recommendations of this committee have not been supported by recent observations. One recommendation made by the committee and adopted by the Board of Trade was that structures in exposed places should be built to withstand wind pressures of 56 pounds per square foot, allowing a factor of safety for rupture of 4 for iron or steel and a factor of safety of 2 for overturning against the action of gravity. The fact does not seem then to have been much appreciated (although it was not unknown) that the action of the wind on large areas is very different from that on small areas. Pressures of more than 50 pounds per

square foot have been indicated by anemometers or small registering gauges many times in Great Britain. Rankine gives 55 pounds per square foot as the greatest pressure observed in Britain, this being observed by Dr. Nichol of Glasgow Observatory. Fidler, however, mentions 65 pounds per square foot as having been registered on a gauge erected by the engineers of the Forth Bridge and, according to Bender, 71 pounds per square foot was recorded at Liverpool on September 27, 1875. We have no reason, however, for assuming that the average pressure on large areas is the same as on small. We have no record of a pressure approaching 56 pounds per square foot being actually measured as being exerted over a large area such as 100 square feet; and various observations made by different individuals have proved to us that in the observations in question the average pressure on a large area was different from that on a small one. Experiments were made at the Forth Bridge by exposing two gauges—one large and one small—to the same wind. The pressure per square foot exerted on the larger gauge, which measured 15 feet by 20 feet, was only from 60 to 70 per cent. of that exerted per square foot on the smaller gauge, which was only 1½ square feet in area. There are many bridges and other structures now existing in different parts of Britain which were erected at a time when it was not the custom to allow much or anything for wind pressure and which could not withstand a pressure of anything like 56 pounds per square foot.

Sir J. Wolfe Barry made experiments on wind pressures on the Tower Bridge. A bascule of this bridge furnishes about 5,000 square feet of area and Sir J. Wolfe Barry calculated from the power required by the actuating engines, that, while small anemometers on the fixed parts of the bridge adjoining the bascules registered 6 pounds to 9 pounds per square foot, the wind pressure on the bascules was only 1 pound to 1½ pounds per square foot.*

That wind pressure per unit area decreases with the extent of the surface was noted in the eighteenth century by several experimenters, including De Borda and Hutton. The results got by De Borda in one set of experiments are given in the following table:—

Surface in square inches.	Intensity of pressure.
9	100
16	109
36	119
81	129

There are two reasons why the average intensity of pressure on a large area should not be so great as on a small area. In the first

* See THE ENGINEERING MAGAZINE, Nov., 1898, page 289.

place, the average velocity of wind is very much exceeded by local currents in the same wind. One of these local currents, striking the full extent of a small area, will cause a high pressure, while it will make little difference to the average pressure on a large area. In the second place, the flow of air is very much upset in the case of a large surface by the lateral flow of the air from the front of the surface, and the velocity of the air for a considerable distance in front of the large surface (or rather, the component of this velocity at right angles to the surface) is probably much reduced.

Mr. T. Seyrig has tabulated the particulars of a number of railway cars and wagons of the Southern Railway of France which have been overturned by the wind. From these particulars it results that the pressure exerted by the wind must have been from 26 to 34 pounds per square foot. It is noteworthy that in every case recorded there were other vehicles in the same train which would have required higher pressures to upset them and which were not upset. There were also wagons which were thrown off the rails and not upset; but, as the wind pressure to accomplish this cannot be satisfactorily ascertained, these cases need not be considered. Professor Gaudard also has given particulars of the upsetting of trains in France—in this case between Narbonne and Perpignan—from which it appears that the pressures were from 30 to 50 pounds per square foot. It should be noted that this is a particularly stormy locality.

We have, therefore, fair grounds for the belief that the wind pressure on large areas need never in Britain be expected to approach 56 pounds per square foot. Constructing a bridge or other large structure to withstand a wind pressure of 56 pounds per square foot with the usual factors of safety, seems therefore to be incurring an unnecessary expenditure. If a structure is arranged to withstand an overturning moment due to a wind pressure of 56 pounds per square foot and has a factor of safety of 2, it will require a wind pressure of 112 pounds per square foot to overturn it. Now the maximum ever experienced in Great Britain is probably well within a third of this. It must also be noted that a mere puff of wind will not overturn a massive structure. In the instance just given a momentary pressure of even 112 pounds would in most cases not suffice; a continuous blast would be required to overcome the inertia.

The allowance for 56 pounds per square foot wind pressure is a serious matter with large bridges. Sir Benjamin Baker has calculater that, in some of the members of the Forth Bridge, the maximum forces due to dead load, live load, and wind pressure are as follows:—

Dead load, ... 2282 tons.
Live load, ... 1022 tons.
Wind ..... 2920 tons.

It will be seen that the force allowed for wind pressure almost equals the dead load and live load put together and it must be remembered that the provision for wind pressure is responsible for some of the dead load. Sir J. Wolfe Barry in his address to G section of the British Association in 1898 said:—

> "It is difficult to imagine the amount of money which has been wasted in unnecessary provision against wind strains of 56 pounds per square foot on large areas in consequence of this hurried generalisation from insufficient data. I know something of what the provision for 56 pounds on the square foot for wind cost at the Tower Bridge, and I do not wish to mention it; but if the public had been told that the dictum of experts arrived at, however hastily, in 1880, was to be set aside in the construction of that bridge all confidence would have been beforehand destroyed in it and I suppose no Committee of Parliament would have passed the Act."

Fidler considers that wind which will exert a pressure for overturning carriages of 30 pounds per square foot will record on a dynamometer a pressure of 40 to 75 pounds per square foot. Anglin is of opinion that for large areas it is sufficient to assume a maximum pressure of 45 pounds per square foot over the whole surface. Still it cannot be said that we have reliable information as to how much to allow for wind pressure on bridges and buildings. Much time and labour have been spent on experiments, but knowledge useful to engineers is still far from complete. Since the days of Sir Isaac Newton there have been many experimenters on wind pressure. The French general Didion did much in this way, and among others may be mentioned De Borda, Robins, Rouse, Vince, Edgeworth, Rumford, Piobert, Thibault, and Hutton. As however different experimenters used different apparatus, there is a great want of uniformity in the results obtained. I may here give a few of the many formulæ that have been proposed at one time or another for calculating the wind pressure from the velocity of the wind.

Rouse's formula is

$$p = \frac{V^2}{200}$$

where p denotes pressure in pounds per square foot and V velocity in miles per hour. This formula was adopted by Smeaton (it is sometimes called Smeaton's formula) and has been used to a considerable extent.

Didion's formula in British units is

$$p = 0.0036\ V^2$$

the letters representing the same as in Rouse's formula. Didion's formula gives considerably lower pressures than Rouse's.

A formula of modern date is that of Mr. W. H. Dines who based it on the result of lengthy experiments carried out at Hersham in Surrey. Dines' formula is

$$p = V^2 \times 0.003$$

the letters representing the same as in Rouse's and Didion's formulæ. Dines' formula gives slightly lower results than Didion's.

Hawksley's formula is

$$p = \frac{v^2}{20}$$

where p denotes pressure in pounds per square foot and v velocity in feet per second. This formula is based on scientific reasoning, but the assumptions made are quite unwarranted. This formula gives higher pressures than any of the others here cited. The results of the four formulæ are compared in Table III. As, however, the pressure on a large area has been shown to be different from that on a small area for the same wind velocity, these formulæ are obviously of little use for general application.

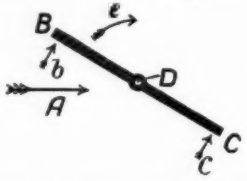


FIG. I. EFFECT OF WIND PRESSURE ON INCLINED PLANE.

Besides the question of total pressure it is important to know how the pressure is distributed over a structure. It seems to be evident from numerous experiments and observations that, when a plane surface is inclined to the wind, the pressure is greater at the forward than at the rear end. That is to say, if A, Figure 1, represents the direction of the wind, and B C is a plane exposed to the wind pressure, the normal pressure exerted on the plane at B as represented by the arrow *b* is greater than the normal pressure exerted on the plane at C as represented by the arrow *c*. If therefore the plane be pivoted at its centre D (the pivot being normal to the paper) it will tend to rotate in the direction of the arrow *e*, till it lies at right angles to the direction of flow of the wind. This explains why a throttle valve pivoted about a diameter in a steam pipe tends to close with a flow of steam.

Some interesting experiments were made about seven or eight years ago by Mr. J. O. V. Irminger, engineer and manager of the municipal gasworks at Copenhagen, and Mr. H. C. Vogt of the same city. The draught from a chimney 100 feet high was used to draw air through a duct measuring about 9 inches by 4½ inches. This is

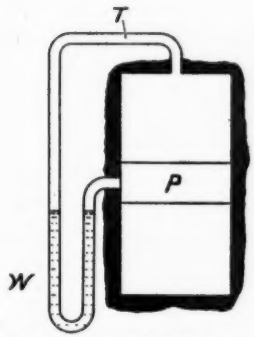


FIG. 2. APPARATUS FOR MEASURING WIND PRESSURE.

shown in section diagrammatically in Figure 2. A plate P 1⅝ inches broad was extended across this duct and was so fitted that its inclination could be altered at will. This plate although flat was hollow and its interior, by means of a trunnion, was put into communication with one leg of a water gauge W, the other leg of which, by means of the tube T, communicated with the interior of the duct. The plate P was provided with several holes. Only one hole was left open at a time, the others being stopped, and the pressure inside the hollow plate was assumed to be equal to the pressure exerted on the plate in the region of the hole. The water gauge indicated the difference between this pressure and the pressure in the duct. The experiments showed, not only that the pressure near the forward edge of the windward side of the plate when the latter was inclined was greater than that near the rear edge (the fact which has just been mentioned with reference to Figure 1), but also that the normal pressure near the forward edge was considerably greater when the plate was inclined at 45 degrees than when at 90 degrees to the direction of air flow.*

The fact is fairly well established that the pressure on the inclined roof of a house is greater near the eaves than near the ridge, and some experiments would lead us to believe that there may even be a negative pressure near this ridge, as shown in Figure 3, where the large arrow indicates the direction of the wind and the small arrows indicate by their length and direction of pointing the intensity and sign of the normal pressure on the roof. The phenomenon of negative pressure is not at all inexplicable, if we consider the probable motion of the air over the roof as shown in Figure 4. Experiments and observations have shown that there may be and probably always is a negative pressure or upward

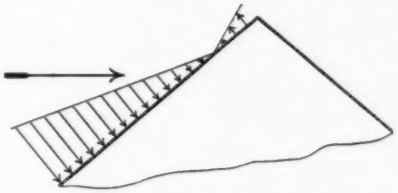


FIG. 3. ILLUSTRATING WIND PRESSURE ON A ROOF.

* See THE ENGINEERING MAGAZINE, July, 1899, page 671.

suction over the top of a gas holder during a heavy wind. Of course it will be understood that this is only relative to the ordinary atmospheric pressure as measured by a barometer. Mr. Irminger of Copenhagen, by means of a registering pressure gauge, ascertained that during a wind that varied from 29 to 70 feet per second the pressure inside a gas holder 170 feet diameter and 90 feet high fell from 6.25 inches to 5.83 inches. This is equal to a lifting force of 2.2 pounds per square foot on the top of the holder. Everyone is familiar with the corresponding upward pull exerted by a strong wind on an umbrella.

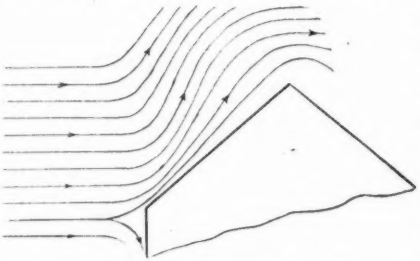


FIG. 4. WIND STRIKING A ROOF.

The nature of the pressure on a cylinder with a vertical axis is important, as this is the form of many structures which have to be constructed to withstand the wind. Experiments show that the positive pressure on a cylinder due to wind pressure extends over less than half its circumference (some experimenters put it at less than a fourth), the rest of the circumference being subjected to a negative pressure. Figure 5 illustrates this, the large arrow indicating the direction of the wind and the small arrows the intensity and sign of the pressure on the cylinder. This diagram is intended however only to give an idea of the nature of the pressure on the cylinder and not to be correct quantitatively. For this we require further experiments. The experiments of Berthon seemed to show that the suction at the sides of the cylinder was greater than at the back, the intensity of pressure being somewhat as shown in Figure 6.

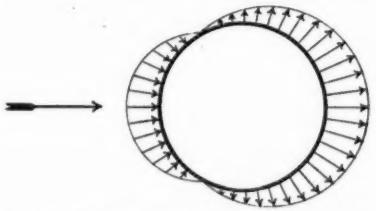


FIG. 5. DIAGRAM ILLUSTRATING THE WIND PRESSURE ON A CYLINDRICAL BODY.

Another important matter of study in connection with wind pressure is the relative resistance to the wind offered by bodies of different shape. A round chimney is generally suposed to offer less resistance to the wind than a square one of equal height and equal capacity. This can be deduced from De Borda's experiments and from general

observations. What is the ratio of the resistances is however a question which can hardly be said to be settled.

Rankine gives the formulæ

$$P = ps \text{ for a square chimney,}$$

$$P = p\frac{s}{2} \text{ for a round chimney,}$$

where P denotes the total pressure against the chimney (presumably in the line of motion of the wind), s denotes the area of a diametrical vertical section of the chimney (presumably at right angles to the line of motion of the wind) and p the greatest intensity of pressure of the wind against a flat surface (presumably normal to the wind). According to Rankine, therefore, the resistance of a square chimney with one side facing the wind is to be taken as double that of a round chimney whose diameter equals the side of the square chimney. A round chimney of equal horizontal section to the square one would then have a resistance of 56 per cent. of that of the square one.

Trying to arrive at a result by calculation is not of much use unless we know how the air acts on the square and on the round chimney respectively. This we know very little about. If we make certain assumptions, we can by theory find the relative resistances of bodies of different forms. For example, if we assume that wind consists of a series of small particles uniformly distributed and travelling all with the same velocity in parallel paths, and if we assume that when the particles strike a fixed body the angle of incidence is equal to the angle of rebounding, and if we further assume that the particles on rebounding never collide with each other, then the pressure P on a flat surface normal to the wind will be given by the equation

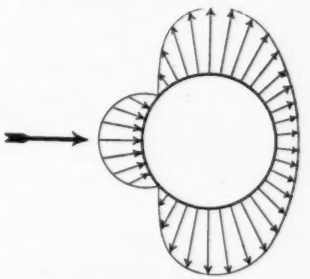


FIG. 6. DIAGRAM ILLUSTRATING THE WIND PRESSURE ON A CYLINDRICAL BODY.

$$P = 2Adv^2$$

where A denotes the area of the surface, v the velocity of the wind, and d the density or mass per unit volume.

With the same assumptions the pressure on a cylindrical surface (such as a round chimney) would be 1 1/3 Adv^2 and that on a sphere would be Adv^2. In the last two cases A is the diametrical section of the body, that is, the product of diameter and height in

the case of the cylinder, and π and the square of the radius in the case of the sphere.

According to this reasoning the resistance of a round chimney would be 1 1/3 × 56 per cent., or 75 per cent. of that of a square chimney of equal height and horizontal section. Making the same assumptions, the resistance of a square chimney with its sides at 45 degrees to the direction of the wind would equal Adv^2 where A is the section across corners. The resistance of the chimney in this position would therefore be $1/\sqrt{2}$ of the resistance when set square with the wind, that is, rather less than the round chimney of equal capacity.

But however little we know of wind pressure we are certain that the assumptions we have made are not only unwarranted but impossible. The calculations are therefore of little value except for mathematical study. We have however learned experimentally a little about the relative resistance of bodies of different shapes. De Borda's experiments showed with small bodies the pressure on a sphere was 0.41 and that on a cylinder was 0.57 of that on a flat plate. A few years ago M. Le Dantec made careful experiments with falling bodies of different shapes. The bodies were guided to fall vertically, the guide, which was a tightly stretched wire, being practically frictionless. The times of starting, stopping, etc., were automatically recorded on bands of moving paper and other precautions were taken with a view to obtaining great accuracy of measurement. Some interesting and valuable results were obtained. The bodies when let go of course started to fall with an acceleration; but a critical velocity was reached in each case at which the resistance, which varied with the square of the velocity, was balanced by the force of gravity. The velocity thereafter was uniform.*

A square plate of one metre side moving at a velocity of one metre per second was found to encounter a resistance of 81 grammes. Plates of equal area but of different shapes—circles, triangles, etc.—were found to encounter resistances which were nearly proportional to their perimeters, the circle having of course the smallest perimeter and therefore the smallest resistance. The fact already mentioned as having been proved, namely, that large areas offer proportionately less resistance than smaller ones, agrees with M. Le Dantec's experiments, as the perimeters of large areas are relatively less than those of small and similar ones.

M. Canovetti has made experiments somewhat similar to those

* See THE ENGINEERING MAGAZINE, Oct., 1899, page 122. Also *Bull. Soc. d'Encouragement*, July, 1899.

of M. Le Dantec. M. Canovetti however caused his bodies to move along an inclined wire. The horizontal distance between the ends of the wire was 280 metres and one end was 71.2 metres above the other. The inclination of the wire varied slightly owing to sagging. Times were taken by a stop watch and some of the results obtained are given in the following table:—

M. Canovetti's experiments with falling bodies.

Form of body.	Pressure in grammes.
Circular plate; area one square metre	80
Rectangular plate; area one square metre	90
Hemisphere with convex side foremost; area of diametric section of sphere one square metre	22.5

In all cases the velocity was one metre per second.

It may be assumed that the average pressure on a body will be much the same whether the body is moving and the air at rest or the body at rest and the air moving. Fidler however says that "it has not yet been ascertained that the pressure of the wind is the same thing as the resistance offered by the air to a moving body." The pressure in the one case will of course vary much more than in the other.

The following table compares the results obtained by several experiments and formulæ for a certain area and a certain velocity:—

Results obtained by different experimentors, and formulæ of the pressure on a circular plate of one square metre at right angles to wind travelling at 1 metre per second.

Formula or experiment.	Pressure in grammes.
Rouse's	122
Didion's	88
Dines'	73
Hawskley's	131
Le Dantec's	72
Canovetti's	80
Perfect impact*	249

It is well-known that a body of umbrella shape offers a great resistance to air moving against its concave side. This fact is made use of in the parachute, and windmills are constructed on this principle. According to General Didion the resistance of a parachute whose depth is one-third of its diameter is about double that of a flat circular plate of the same diameter. This fact is also borne out by the experiments of Hutton.

The total force exerted by the wind on a plate is of course the sum of the positive pressure on the windward side and the negative pressure on the leeward side. For example, if the pressure on the windward side of a plate of 1 square foot area is 50 pounds above atmosphere and that on the leeward side 26 pounds below atmosphere, the effective force on the plate is $50 + 26 = 76$ pounds. The experi-

* That is according to equation near the bottom of page 553.

ments of Du Buat and Thibault seemed to show that the positive pressure on the windward surface of a plate was double the negative pressure or suction on the leeward side. Other experiments however lead us to believe that the relative values of positive pressure and suction depend on the shape and inclination of the plate.

The effective force on a plate is found not to be the same as on a prism whose ends are formed by two such plates, the wind pressure being perpendicular to the plate and to the ends of the prism. In spite of the skin friction on the sides of the prism, the effective force on the latter is less than on the plate. This does not seem unnatural when we consider that the air striking the plate or the end of the prism will be projected laterally and will be able to close in again behind the prism much better than behind the thin plate. There will therefore be greater suction behind the plate than behind the prism.

In many cases it is desirable not only to know the total effective force on a body, but the pressure and suction on its front and rear sides separately. Thus in a house it is necessary to have each wall strong enough to stand the wind pressure or suction (whichever is greatest) as well as to have the house constructed to resist being swept away as a whole. The same thing holds good in box girders or tubular bridges. It should be noted that a wind gauge which consists of a plate which is exposed both front and rear will register a pressure which is the sum of the pressure on the windward side and the suction on the lee side.

The question of the pressures on two parallel plates having a space between them not laterally enclosed is also important. Two such plates occur as the girders of a plate-girder bridge. Baker's experiments with equal parallel discs are interesting in this connection. The total effective force on the two discs was found to be as given in the following table:—

Distance apart in terms of diameter.....	1.0	1.5	2.0	3.0	4.0
Total effective force in terms of effective force on single disc by itself.....	1.0	1.25	1.4	1.6	1.8

As there must be a certain amount of force exerted on the leeward disc, it follows that the effective force on the windward disc is reduced by putting behind it at a distance of a diameter another similar disc. That is, not only does the windward disc shield the leeward one, but the leeward disc shields the windward one. And this is what one would naturally expect on a little consideration; for the air between the discs must be comparatively still and suction on the back of the windward disc be very little. In the case of plate-girder

bridges, therefore, we may assume that the effective force on the windward girder will be less than if it were alone, and the effective pressure on the two girders will depend on the relation between their heights and their distances apart.

We know that in a gale the velocity of the wind is constantly changing. The maximum pressure recorded by a small gauge therefore will not as a rule measure the force to which a structure is subjected. The small inertia of the gauge will enable it to register the maximum force reached during a puff, but a few feet or even a few inches away the pressure at the same moment may be less. Besides this the maximum pressure may last for only an instant. That is to say, the pressure due to a puff of wind may increase to a maximum and then decrease. For example, at Greenwich on January 16th, 1872, the average pressure for each separate hour of six consecutive hours varied from 2.8 to 3.6 pounds per square foot; but the maximum pressure each separate hour was from 30 to 42 pounds per square foot. Now a light gauge will register the very maximum, while the heavy body will be affected only by the average pressure during a small period of time. Consider for example the stability of Cleopatra's needle on the Thames Embankment. We could easily find the uniform wind pressure which would be required to overturn it, but a sudden small gust which merely reached that intensity for an instant would not effect the result; there is more than the weight of the stone to be overcome—there is the inertia. This fact is well illustrated by the way that windows are blown in by gusts of wind which seem to make no impression on the buildings containing the windows, when, by calculation, the windows in many cases ought to stand a greater steady pressure than the building.

A series of comparative tests with gauges which require different amounts of work to make them record would be very interesting and instructive. We might employ spring-actuated plate gauges with large and small masses, or we might cause the pressure on equally massive plates to act on water gauges having large and small sections of tube.

It should be noted that gauges are often affected by buildings or erections in the vicinity and do not register the pressure that would exist in the open. We all know how seriously the draught of chimneys is affected by adjacent objects. It has been suggested that comparatively feeble gusts of wind might rupture a structure if the period of the gusts was equal to the natural period of vibration of the bridge. But the probability of this occurring for more than

two or at most three consecutive gusts seems so remote that its effect beyond this possible maximum periodicity may be neglected.

A large structure is more stable than a small one of a similar shape and nature. That is, it takes a greater wind pressure per square foot to overturn a large structure than to overturn a smaller one of the same shape and the same density, if the structures rely on their weights only to resist overturning and if the material is not ruptured. Consider the column shown in Figure 7, which we will suppose to be of rectangular cross section and to have a height h, a breadth b and a thickness d. Let w be the weight of a unit volume of the material of which the column consists. The small arrows a represent a uniform wind pressure of p pounds per unit area. The large arrow P represents the resultant wind pressure on the column acting at a distance of ½ h from the ground. The large arrow W represents the weight of the column which acts through its centre of gravity, the line of W being at a distance of ½ b from the back of the column. Let us take moments about the edge c, c. The overturning wind pressure will be such that the moment of P equals the moment of W.

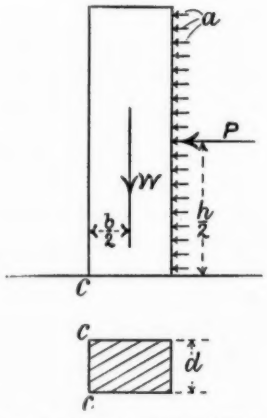


FIG. 7. DIAGRAM ILLUSTRATING THE STABILITY OF A COLUMN.

$$\text{therefore} \quad P \times \frac{h}{2} = W \times \frac{b}{2}$$

$$\text{but} \quad P = hdp$$

$$\text{and} \quad W = hbdw$$

$$\text{therefore} \quad hdp \times \frac{h}{2} = hbdw \times \frac{b}{2}$$

$$\text{therefore} \quad hp = b^2w$$

$$\text{therefore} \quad P = \frac{b^2w}{h}$$

For columns of similar shapes b varies as h, and therefore p varies as one of the linear dimensions. Therefore, if a wind pressure of 20

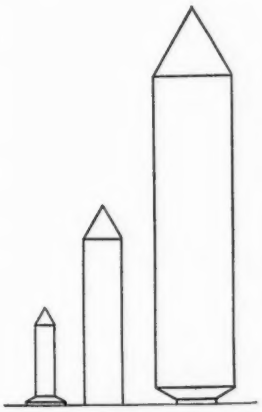


FIG. 8. ILLUSTRATING EFFECT OF SIZE ON STABILITY.

The bases, relatively very different, give equal stability against wind pressure.

pounds per square foot is required to overturn a column 20 feet high, a wind pressure of 40 pounds per square foot will be required to overturn a 40-foot column of the same material and similarly proportioned. If the 40-foot column had a base equal to that of the 20-foot column, instead of being proportionately greater, then the same wind pressure would overturn both. This applies to bodies of any shape.

Figure 8 shows three columns similar except for their bases, which are equal. These columns are equally stable.

This fact may be expressed by the following rule:—

For equal stability against wind pressure, similar bodies require equal bases and not similar bases.

This rule must be taken as approximate only, for there are several considerations which we have left out of account, such as skin friction of the wind on the sides of the structure, the effect of the friction of the ground on the wind pressure on the front lower part of the structure, and the greater intensity of wind pressure on small than on larger areas. The rule, however, is roughly speaking correct and explains why in nature an insect has such a large leg base and a large quadruped proportionately such a small one.

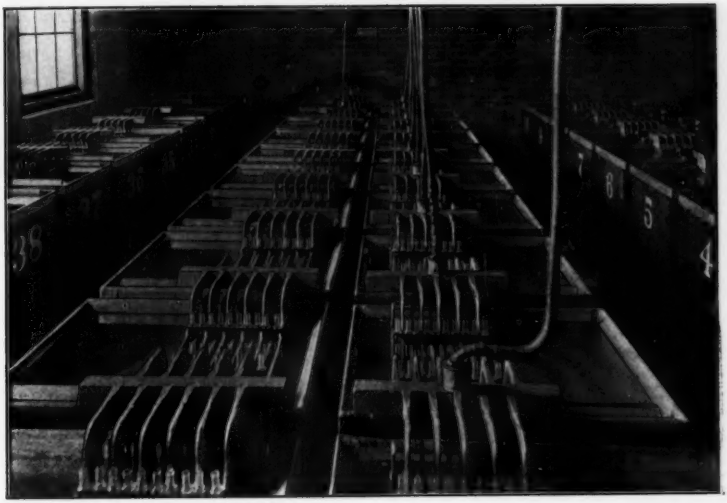
We asumed in considering the stability of the column shown in Figure 7 that it would tilt about the edge *c*. We did this because we were considering stability given by weight only, and not considering the strength of the material. In some cases the material would not fracture and the structure would tilt as has been shown. In other cases the material about the tilting edge would crush. This crushing would not affect the overturning moment, but it would reduce the moment of stability and therefore lessen the wind pressure that the column would stand.

This article will not be complete without a few words on tornadoes. We are not troubled with tornadoes in Great Britain, but in America they occur every now and again and contrive to do a maximum of damage in a mimimum of space and time. The destructive power of some of these tornadoes has been terrific, but happily their

track is usually very narrow and it seems the wisest course as a rule not to attempt to construct buildings to withstand them but to take the chance, which is really extremely small, of a tornado ever striking them. At a meeting of the American Society of Civil Engineers, the widths of the tracks of several tornadoes were given. The Marshfield tornado was 1,800 feet wide, the St. Charles tornado not more than 60 feet, and the Medford tornado had a track only about 13 feet wide.

It is not in the province of this article to discuss the cause of tornadoes. The cause however involves a low barometric pressure at some place, and this affects the nature of the destruction caused by the tornado, and the nature of the provisions to withstand it if such provisions are to be made. In some cases damage seems to be done by suction. In the tornado or cyclone or "vacuum storm," as it has been very appropriately called, which swept through the cities of St. Louis and East St. Louis on the evening of May 27th, 1896, there were unmistakable signs of damage having been done by a sudden fall of pressure. Walls of houses in many cases fell outwards, evidently due to the excess of pressure inside the houses when the pressure outside was suddenly reduced. The capacity for harm of a sudden fall of pressure will be evident when we consider that every inch of mercury equals a pressure of 70.7 pounds per square foot. If therefore the barometric pressure were suddenly reduced outside a building by an inch and a half, the walls of the house would be subjected to the enormous pressure of 106 pounds per square foot. Several houses were found after the St. Louis tornado with walls intact but with the lath and plaster torn off the ceilings of the rooms immediately below the attics. In these houses there was no flooring on the attics, and the only explanation of the phenomenon seems to be that, when the vacuum wave passed the house, the excess of pressure in the rooms got out by windows or flues or otherwise, but that in the case of the attics with no adequate air exits, the excess of pressure of the imprisoned air burst down the ceilings of the rooms below. In many cases in which the outside walls of houses were in part thrown down (outwards), light partitions and light furniture were left unmolested, showing that there had been no violent air currents inside the house.*

* See paper of Mr. Julius Baier, Pro. Am. Soc. Civil Engineers, Jan., 1899.



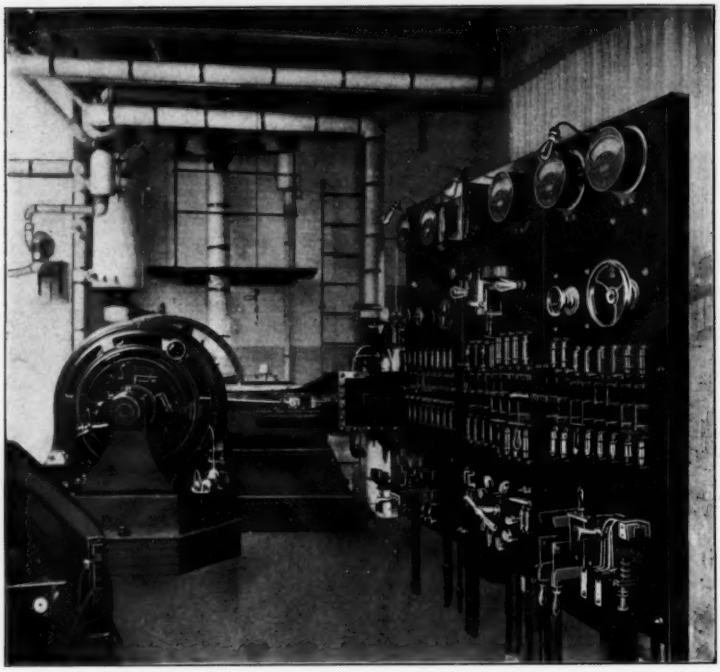
A Chloride Accumulator Plant.

ECONOMY IN THE DESIGN AND OPERATION OF ELECTRIC PLANTS.

By Percival Robert Moses.

A NUMBER of articles on the general subject of isolated electric plants have appeared in THE ENGINEERING MAGAZINE, the majority having for their theme a more or less detailed study of the comparative cost of electricity from this type of plant and from the central station. Anyone studying the figures carefully must have been struck by the wide dissimilarity in the results from different plans having the same general characteristics, and it is the purpose of this article to point out some of the ways in which economy in operating cost may be obtained.

It is well to bear in mind the fact that operating expense is not fuel and labor cost only, but includes fixed charges, repairs, cost of water, oil, and sundries, which in the aggregate frequently exceed the cost of either fuel or labor and sometimes of both together. The ad-



BOOSTER AND SWITCHBOARD, PLANT OF HASTINGS SONS PUBLISHING CO., LYNN, MASS.
In connection with 200-ampere chloride accumulator installation.

mirable papers written by Mr. Isaac D. Parsons and published in this Magazine for January and February, 1902, brought out clearly the importance of these items, particularly that of fixed charges. The largest plant described in these papers was also the most costly per unit of power delivered—a result contrary to all reasonable anticipation, and due in great measure to excessive first cost and consequent high interest and depreciation charges.

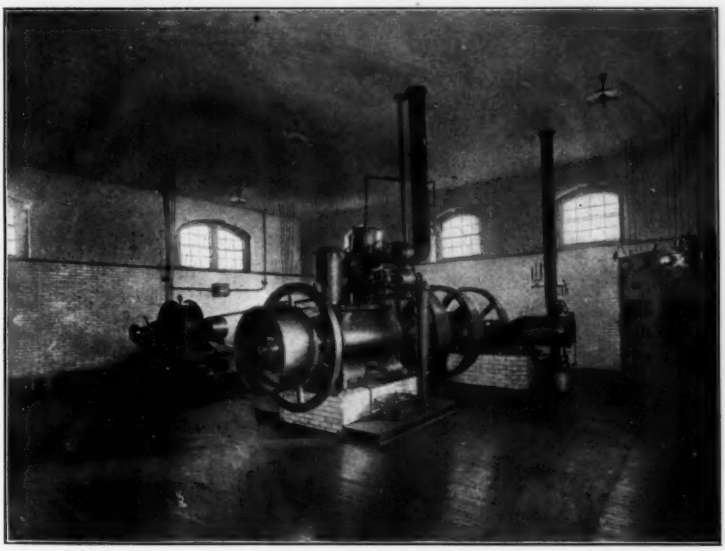
In this connection the following quotation from Wellington (The Economic Theory of the Location of Railways,) adapted to this subject, is apropos:—

> "No increase of expenditure over the investment minimum is expedient or justifiable, however great the probable profits and value of an enterprise as a whole, unless the increase can, with reasonable certainty, be counted on as a good investment."

If this were framed and hung above each consulting engineer's

desk, it is certain that the investment, in this case, at least, *would* be both "expedient and justifiable." The most frequent cause of extravagant installations is found in the fact that sufficient return is obtainable upon the whole expenditure to warrant the investment, and the lack of returns from a number of more or less important items making up the grand total is overlooked.

On the other hand, again quoting from Wellington, no *saving* of expenditure is expedient or justifiable when it can be counted on with reasonable certainty that the additional expenditure at least would in itself be a paying investment. This is to be qualified by the proviso that the additional expenditure can never be a profitable one if it endangers the successful completion of the plan as a whole.



MAIN GENERATING PLANT FOR BILTMORE, THE ESTATE OF GEORGE W. VANDERBILT, ESQ. Two Hodge boilers of 125 and 100 horse power; Ball & Wood engine belted to a General Electric 60-kilowatt 2,300-volt monocyclic generator, and Westinghouse engine belted to a similar unit. Transmission of three miles to transformer station near Biltmore House. Used in connection with storage battery shown on page 571.

It is not possible in a paper of this character—nor, in fact, in any thing short of a book—to treat fully of plant costs and methods of reducing operating expense, but a few facts gathered from practice may be of use.

The basis of design of plants must be cost, as in the end that plant which will give the best results at the least cost is the one to be in-

stalled. We must therefore begin our consideration of the subject by establishing some definite cost data. Table 1 below shows actual costs of boilers installed. Water-tube boilers differ largely in price for different types. Those listed are the "B. & W." type.

Type	Size in horse power.					
	60.	80.	100.	125.	150.	300.
H. T. for 100 lb. pressure...	$850	$900	$1,050	$1,250	$1,300	.....
H. T. " 125 lb. " ...	950	1,000	1,100	1,150	1,400	.....
Water-Tube	$18 to $23 per h. p.				$15 to $18 per h. p.	

TABLE I. COST OF BOILERS FOR ISOLATED ELECTRIC PLANTS.

Table 2 shows the actual cost of engines and standard sizes. The costs of high-speed engines are for direct-connected units and include metallic packing, tools, sub-base, shaft and outboard bearing for dynamos, and erection in cities near New York. It is particularly interesting to note that three engines of 80 horse power each cost the same as one of 225 horse power, and that two 125-horse-power engines cost $300 less than one of 225 horse power. This is contrary to the usual belief, and has an important bearing on the design of small plants, as it allows division of the equipment into a number of units without increased—and frequently with decreased—first cost, incidentally making the installation reliable, flexible, and efficient.

Type.	Size in horse power.							
	40.	60.	80.	100.	125.	175.	225.	300.
High-speed, simple	$900	$950	$1,200	$1,250	$1,600	$2,200	$3,500	....
" " compound ...	....	....	....	2,600	3,000	3,250	4,000	4,500
Simple Corliss	1,350	1,800	1,900	2,000	2,200	2,900	3,600	4,900
Compound Corliss	....	....	....	....	....	3,600	....	6,000
Simple, four-valve	....	....	....	1,650	2,000	2,850	3,400	4,200
Compound, four-valve ...	....	....	....	2,650	3,050	3,800	4,250	5,000

TABLE II. COST OF ENGINES FOR ISOLATED ELECTRIC PLANTS.

There is another point to be mentioned in connection with the table of engine costs, viz., that the cost of the sizes of engines shown is not dependent on the steam pressure, provided this is 80 pounds or more; for although a 10-inch engine with 125-pounds pressure and an 11 or 12-inch diameter cylinder will indicate more than 80 horse power, the frame of the 10-inch engine is not designed to carry this load and it is generally necessary to use the 12-inch frame with a cylinder of small diameter. This is not true with a few makers, but it is the rule.

No figures are given for high-speed engines arranged for belting. Those given for direct-connected units may be used, the cost of sub-base, etc., being balanced by the belt and belt-tightening arrangement.

Where belting is permissible a Corliss or four-valve engine is advisable, as economy, life, and reliability are gained.

GENERATOR PLANT, ASTOR BUILDING, N. Y.
Two 50-kilowatt and one 75-kilowatt direct-connected units, 115 volts. Used in connection with storage battery shown on page 570.

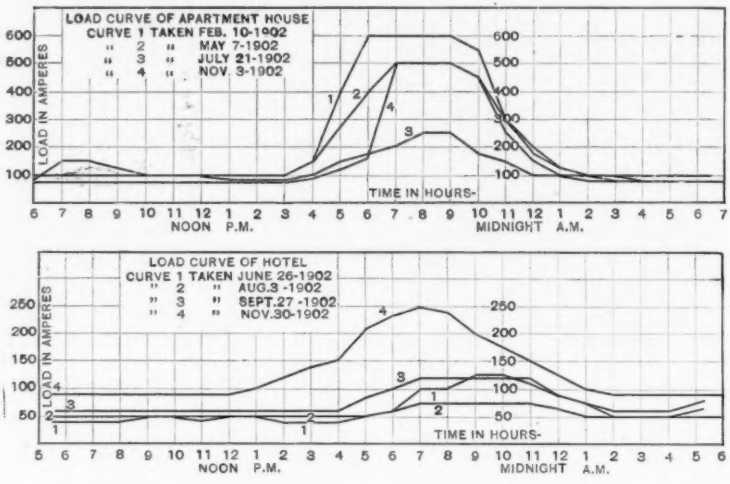
Table 3 shows costs of various kinds of dynamos. The variation in price is similar to that of engines; the small sizes up to 100 kilowatts cost from $23 down to $15 per kilowatt. Above this size the cost per kilowatt does not decrease materially, making it entirely possible to put three 100-kilowatt dynamos for the same price or less than one 300-kilowatt machine.

Type.	Size, kilowatts.								
Direct Current.	25.	30.	40.	50.	75.	100.	150.	250.	300.
Multi-polar, direct-connected	$550	$650	$850	$1,000	$1,300	$1,500	$2,750	$3,750	....
Multi-polar medium speed belted	425	600	750	900	1,100	1,200	....	....	....
Alternating current 2 or 3 phase belted..	750	...	...	1,400	....	....	2,750	3,800	4,750

TABLE III. COST OF GENERATORS FOR ISOLATED ELECTRIC PLANTS.

The relatively smaller cost per unit of size of the smaller machines is due to the fierce competition of manufacturers, and is made possible by the small investment required for tools and shops. The larger units demand special tools, heavy cranes for handling large parts over a large area, and more capital tied up, preventing the decrease in shop cost which might be expected with increased size.

With these figures as a rough basis the design of the plant for economy becomes easier; it involves a load curve showing the amounts of power and light that will have to be supplied during different hours of the day. After this is plotted the plant should be divided into as few units as will enable the boilers, engines, and dynamos to work at or near their maximum economy, and at the same time provide a sufficient number so that in the event of the breakdown of one the others



TYPICAL LOAD CURVES OF A HOTEL AND OF AN APARTMENT HOUSE.

will be capable of carrying the load. The limit of size of one of the units is generally fixed by the day load—principally power; the total plant capacity is fixed by the maximum possible load, and the size of the other units by the maximum probable load. A number of load curves of buildings were shown in the papers referred to and a few more are given below.

A casual study of the load curves of an apartment house, an apartment hotel, or an office building, shows a very light load, from one-fifth to one-fourth of the maximum, during three-fourths of the time, and a heavy load during the remainder, approaching three-fourths of the total capacity connected to the lines. This would indicate a small unit (for day work) and two large units, the sizes to be such that either of the large units (together with the small one, in emergencies) could supply the demand for the heavy-load period; ordinarily the two large ones would run together in heavy-load periods.

Where electric elevators are installed another factor is introduced through the starting current required and the small average running current. On this page is shown a load curve of a building without elevator load, and above it a typical elevator load curve with an average requirement of 15 kilowatts for light and power and a momentary maximum of 60 kilowatts. If good service, noiseless operation, and long life are essential in a plant of this character, it is necessary with the standard-design engine and dynamo to install a unit for such work having a capacity of at least the "average maximum," if such a term is permissible. If this is done the plant can not be economical in steam consumption, as during four-fifths of the time the engines are running at but 10 to 15 per cent. of their rated capacity, and during the remainder at rapidly and continually varying points of cut off and rates of expansion.

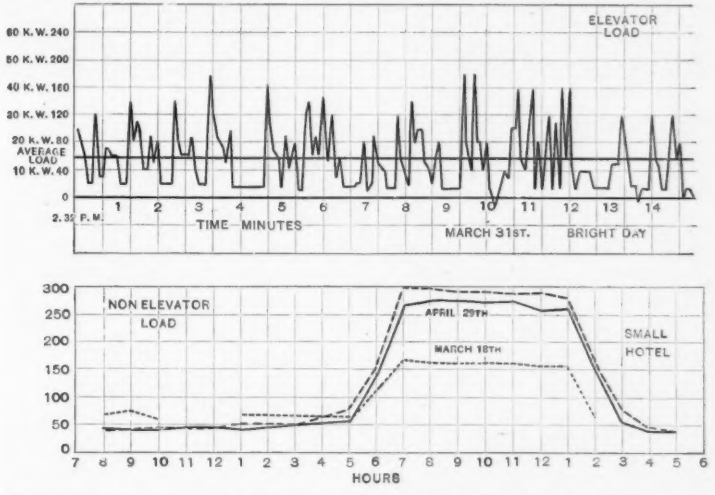
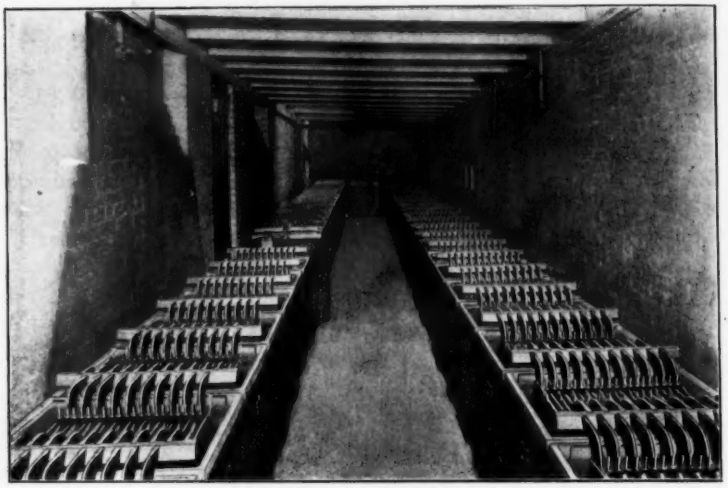


DIAGRAM OF LOAD-CURVE OF A BUILDING WITHOUT ELEVATOR, AND OF A TYPICAL ELEVATOR LOAD CURVE.

The remedy for this state of affairs is found in some method of storing energy, and the only one which has received practical development, as yet, is the electric storage battery. Other methods have been proposed, but not yet developed in working form. This auxiliary to the plant is useful mainly in two ways, one of which is to equalize the load by receiving and delivering electricity (i. e., charging when the elevators are not drawing more than the average current, and dis-



STORAGE BATTERY ROOM, ASTOR BUILDING, N. Y.

60 chloride accumulators, having capacity of 200 amperes at nominal discharge rate. Electric Storage Battery Co.

charging when more than the average is required) and the other is to supply all the elevator and lighting current required during light-load periods. There is a third use, viz., to supply the peak of the load during the heaviest lighting period; but the excessive cost of storage batteries for large quantitative discharges, compared to the cost of engines and dynamos, prevents their use for this purpose except in instances in which the heavy load is of very short duration, as in some office buildings and factories.

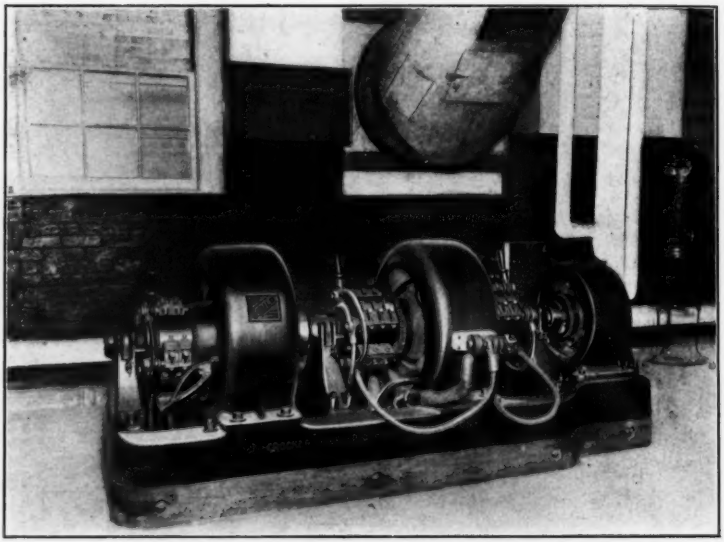
The cost of storage batteries is their only real drawback when operated under intelligent supervision. It varies from $11 per ampere hour for small batteries of 240 ampere-hours capacity, or $8 per ampere hour for 500 ampere-hours capacity, to $7.50 per ampere hour for several thousand ampere-hours capacity. These capacities are based on an average discharge for eight hours at 120 volts. These figures include constant-current booster, or similar automatic regulating device, and switchboard, but no wiring. Where elevator current is to be supplied, the cost of the battery is largely offset by the saving in boiler, engine, and dynamo equipment.

In a plant recently designed, the cost of the engines and dynamos required where no storage battery was used, (two large generating units and one small one) was $10,200; and the cost of the engines

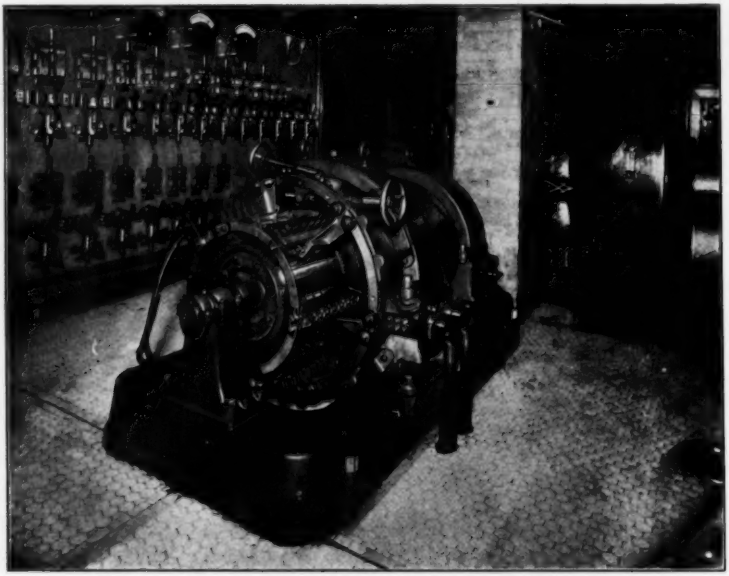
and dynamos required with a battery was only $7,900. The price of the battery was $4,000, making the net cost of its installation only $1,700. With the first design, the smaller engine would run constantly during light load at about 15 per cent. of its full capacity, with momentary requirements of 100 to 125 per cent., requiring from 15 to 20 pounds of coal per kilowatt hour delivered under actual working conditions; and the plant would have to run at all times. Under the second plan no engine would run after one o'clock at night, nor in the daytime in mild or hot weather, and at other times the plant would operate at from one-half to three-fourths rated capacity, using from 6 to 10 pounds of coal per kilowatt hour. These figures are deduced from a large number of daily records kept for a period of several years in a number of plants. The efficiency of a storage battery is not high—from 70 to 80 per cent.—but this is of small consequence, as it applies only to that portion of the current it discharges. Usually this is from 5 to 10 per cent. only of the total current supplied by the plant, so a loss of 20 per cent. in passage through the battery would be only from 1 to 2 per cent. of the total power supplied.

THE BILTMORE BATTERY ROOM, SHOWING ARRANGEMENT OF CELLS.

60 Gould cells, capacity 2,000 amperes at 8-hour rate. Cells glass covered to prevent loss and exclude dust. Gould Storage Battery Co.



BOOSTER IN THE COLLIER BUILDING, NEW YORK.
Capacity of 400 amperes at 30 volts. Used in connection with 56-cell Gould storage battery.



BOOSTER AND SWITCHBOARD, EXCHANGE COURT BUILDING, N. Y.
In connection with Electric Storage Battery Company's chloride accumulators.

Besides the reduction in operating expense, a battery offers numerous inducements, among them steady lights, free from fluctuations, a reserve capacity in case of accident to the steam main or shut off of water supply, and absence of noise or heat when the electric plant is shut down.

Another point in the design of electric plants where large wastes are usual and avoidable is in the grates for boilers and the methods of fuel burning. Cheap fuel well burned is more vital to the cheap production of power than any economy that can be introduced in the design of the engines or other machinery. If fuel at $1 to $2 per ton

STORAGE BATTERY, COMMERCIAL CABLE BUILDING, NEW YORK.

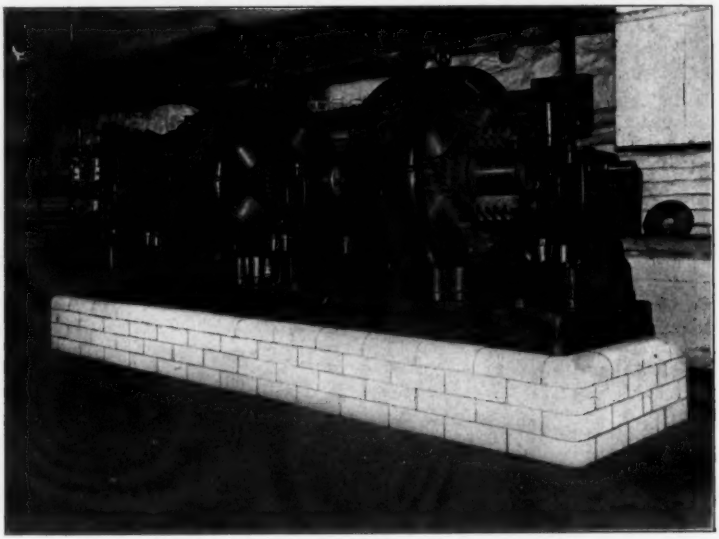
62 Gould cells. Capacity 80 amperes for 8 hours, 160 amperes for 3 hours, 320 amperes for one hour.

can be burned to give results one-half as good as fuel at $3.50 to $4 a ton, more saving will result than there will from a reduction in steam required per indicated horse power in the engine from 35 pounds to 25 or 15, as any saving in the cost of making steam reduces the cost of operating all types of apparatus using it, whether they are pumps, boilers, ice plants, or engines, while an increased economy in one particular type of apparatus saves only while that apparatus is in operation.

Several systems for burning low-grade fuels and waste products are in operation, among them bagasse and saw-dust burners, waste-gas boilers, and blowers combined with pin-hole grates and special

settings for the lowest grades of anthracite, such as rice, barley, and screenings, costing from $1.50 to $2.25 per ton under normal conditions. In a test on one plant, different grades of anthracite from pea down to screenings were tried with different grates and appliances. Boilers side by side were operated under identical conditions over extended periods, and screenings were finally adopted with the use of a patented system of burning. The cost with this grade of coal per pound of water evaporated was less than one-half that with the largest size tried. Such systems, however, should be used only after careful investigation, as a great many are of no value or are so complicated as to make them a nuisance.

A third economy, less important except where refrigerating machinery is installed, is in the water supply. Whether water is pur-



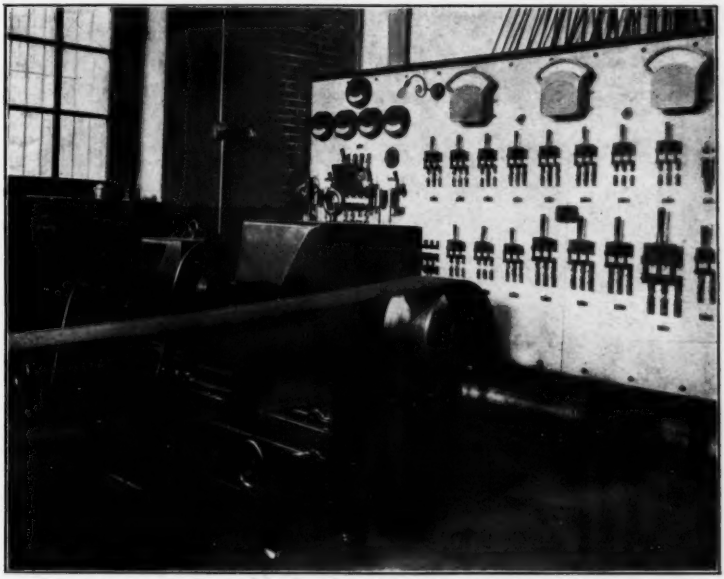
BOOSTER IN COMMERCIAL CABLE BUILDING, NEW YORK.

Used in connection with the storage battery shown on page 573.

chased or pumped it costs something, and in cities it is an important item in the expenses of a plant. The water required for steam costs in New York about 25 or 30 cents per ton of coal burned under the boiler; one-fifth of this or less may be saved by using an open feed-water heater and returning water to the boiler; the remainder can be saved only by use in the heating system or by a condenser, and this latter is impracticable unless accompanied by a cooling tower or by

available salt water. The cooling tower will waste more water than the steam condensed, so that from the point of water saving it is not valuable; the accompanying reduction of steam consumption in the engine, however, makes it worthy of careful consideration where its installation is feasible.

The open feed-water heater is a money saver when water is expensive, provided it is accompanied by an efficient grease extractor



GENERATOR AND BOOSTER AT BILTMORE, DRIVEN BY 3-PHASE INDUCTION MOTOR.

and a properly designed pump. If oil is allowed to enter with the steam and is fed to the boilers, or if the pump is not fitted for hot water and placed sufficiently below the heater to avoid hammer, the saving in water is counterbalanced by leaky boilers and noisy pumps. When refrigeration is an important part of the plant, and water is expensive, either the water must be used for other purposes, or some method must be adopted of cooling and re-using it; otherwise its cost is greater than that of the coal for operating the plant.

A fourth economy, which has been treated fully in other papers* and which space will not permit the discussion of here, is the more or less complete use of the waste or exhaust steam from engines for

* The Centralisation of the Steam Condensing Plant. H. G. V. Oldham, in THE ENGINEERING MAGAZINE for October and November, 1900.

A RESIDENTIAL PLANT—BOOSTER, CHLORIDE ACCUMULATORS, AND SWITCHBOARD.

heating, boiling, or similar moderate-temperature applications. Where all the exhaust derived from a plant can be used, an economy closely approaching perfection is obtained which cannot be equalled by any other form of engines. The use of exhaust steam for distillation, for sugar making, and dozens of other manufacturing applications is well known, and it is along this line rather than along that of engine development *per se* that the greatest savings of the future will be effected.

COST FINDING METHODS FOR MODERATE-SIZED SHOPS.

A SUCCESSFUL EXAMPLE UNDER THE PREMIUM WAGE SYSTEM.

By Hugo Diemer.

The series of cost-keeping articles of which this is the second paper began in our preceding issue with an exposition, by Mr. H. L. Arnold, of the methods of the Bigelow boiler-manufacturing company. The purpose of every one of the articles will be to furnish a working description of a practical system, in actual use in a shop where it has stood the test of time and been proved successful and sufficient. The reproduction of the forms and blanks in immediate connection with the explanatory text makes the papers particularly useful and interesting to those who are concerned in the introduction or the working of methods of shop accounting.—THE EDITORS.

DURING the past few years numerous discussions of the premium wage system have appeared in technical literature. Practical examples of cost finding and stock tracing under the system have not been so numerous. The methods adopted in its successful introduction into a flourishing machine shop are herewith outlined.

The Cincinnati Milling Machine Company employs from three hundred and fifty to four hundred workmen in the manufacture of milling machines, grinding machines, and attachments. The number of different parts manufactured aggregates about four thousand, and the distinct machine-shop operations on each part vary from four to thirty. Since the beginning of the past year the company has been establishing premium pay rates, beginning with certain operations on which available data and experience enabled them to set the time allowance with confidence as to its correctness. The system is constantly being extended to cover further operations, the intention being to have a definite time set on every separate standard operation. Two men act as time keepers. These men spend their entire time in making circuits of the factory and filling out the slips shown in Figure 1. There is a nail or hook convenient to each man's place of work on which hangs a book of these tickets. The first ticket is issued on Monday morning is given No. 1, and they are numbered consecutively until closing time on Saturday. The tickets are written in duplicate, and each man's duplicate tickets, showing his premium earnings, are returned to him with his premium pay.

ORIGINAL 18 = 410

THE CINCINNATI MILLING MACHINE CO.

Name Kimmick No. 125

No. 2 S.O. 2455 Amt. 12

Name Tables # 4pl

Oper. Mill ends

No. Started	No. Finished	Time Begun	Time Finished	Total Time	Premium Allowance	Gain	REMARKS
12	12	8 / 14	8 / 18	22 3/4	25	2 7/20	
		3 / —	10 / 45				

FIG. I. TIME TICKET.

The actual card is somewhat larger—6 by 3½ inches—of thin white paper. The duplicate (marked "Duplicate" in upper left corner), folds under this by a perforated bottom edge.

The employment of special men for writing out the time tickets has been found far preferable to having the men or foremen fill out tickets themselves. It was calculated that if each man spent ten minutes in filling out time tickets, daily, it would amount to an hour per week. For a fifty-seven-hour week, the value of this time would be one fifty-seventh of the total pay-roll, or one fifty-seventh of about $3,000, a considerably greater sum than the time-keepers' wages, with the disadvantage of no uniformity and very little reliability. The time clerks are young men of about thirty years of age—mature enough to know how to get along in a factory. They are expected to get all the data they need with the least possible consultation of the workmen. Much of their information is obtained from the shop-order tag or tracing slip, which will be explained more fully later, and is shown on page 585.

If in the interval between the time-keepers' consecutive visits to any one workman that man has stopped work temporarily on one order on which he has been working (and for which the time keeper has written say ticket No. 4), and has completed some short orders and returned again to work on order represented by ticket No. 4 when the time keeper next passes him, the time keeper issues a ticket giving it the next consecutive number—in this case No. 5—for the short job done, and notes on the back of the ticket No. 4 covering

the order which was temporarily discontinued "(Date), Deduct —— hours —— minutes, time ticket No. 5."

These interruptions are usually on "foremen's orders," a blank form of which is shown in Figure 2. If work on an order which has been begun is to be discontinued for some time, owing to the arrival of some hurry order, the workman's time ticket is marked "unfinished," and turned in with the tickets for finished work. Unfinished tickets are posted on cost cards in pencil and then filed temporarily in a card-index drawer until the "finished" ticket comes through, when the entries are made in ink.

The "job" or "time" tickets are turned over by the time keepers to the pay-roll clerk who makes from them entries on monthly sheets (a sheet for each man), shown in Figure 3. He checks up the total time reported on tickets against the time as shown by the strip from the clock register. He notes on each time ticket the workman's rate, and extends the labor cost and premium gain where there is any. He uses a rate sheet mounted on a substantial board, with vertical and horizontal guide to assist in his calculations. The board is mounted on a drawing stand by his side so as not to interfere with his desk work. The monthly sheets show each man's time losses as well as his gain,

NOTICE--Foreman will Issue Written Orders for Repairs, Tools, Supplies, Materials, Etc. Worn Out and Broken-Tools Must be Returned.

To X173 **Date** 8/21/02

Repair planer belt

Signed Meyer

Charge Repairs to Mach

FIG. 2. FOREMEN'S ORDER.

Printed repetitively on a roll of white paper. Width as shown. In use, the form gives a little more space for entries, being 5 inches high.

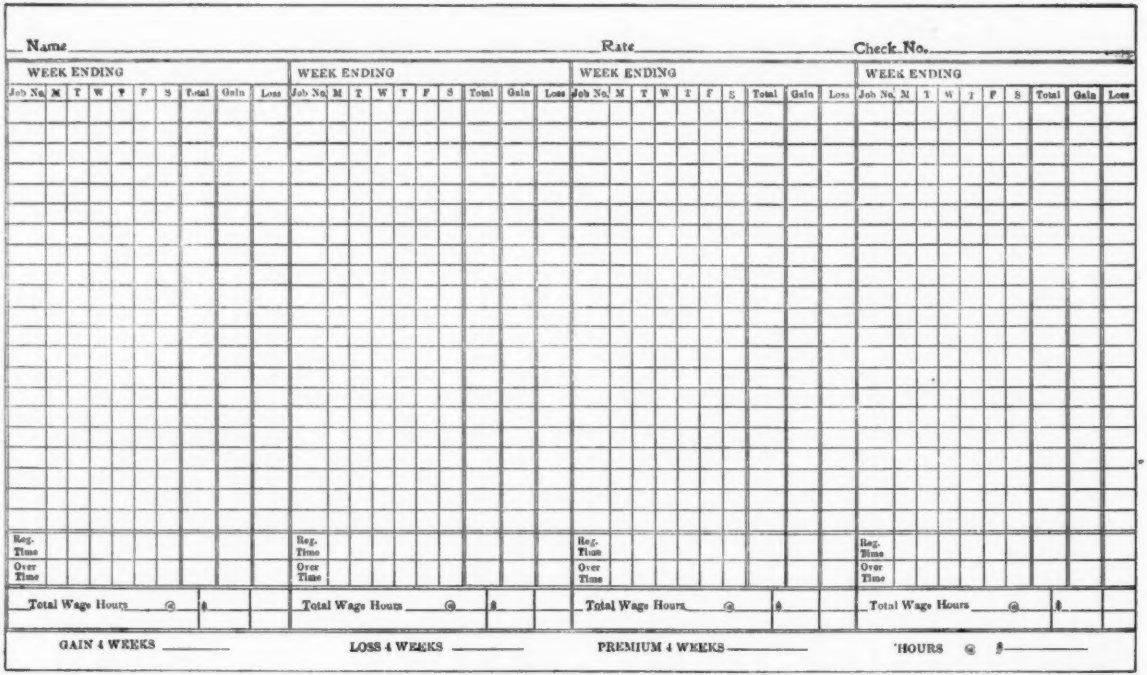


FIG. 3. MONTHLY TIME SHEET.

The original is 12 by 9½ inches; the left margin is extended and punched for binding. Horizontal rulings are in red for the headings and footings and pale blue for the body. Vertical rules are red, except double rules dividing the weeks, which are green. The color system makes the card very easy to read.

so that they become a record of the workmen's efficiencies. The form of a record card showing operations and time set is shown in Figure 4.

From the pay-roll clerk the time tickets are passed to the cost-posting clerks, who post operation, time, rate, and cost on the individual piece-cost cards, a sample of which is shown in Figure 5. Guide card for this set is shown in Figure 6. In posting on these cards use is made of a code of abbreviations representing the various shop operations. The use of the abbreviations reduces the labor of posting by a large percentage. The use of a letter prefix, such as

Part BOX BACK Size { Pl. 1 / Un. 1 1-1/2 } Card No.

OPERATION	MINS. EACH	REMARKS	OPERATION	MINS. EACH	REMARKS
1 Bore & Turn (Outs. & ins.)			B & T	21.6	
2 Keyway for babbitt			K 1	17	
3 Babbitt			B40		not set
4 Bore (Roll babbitt & Oilgroove			B	23.5	
5 Turn			T		not set

FIG. 4. CARD SHOWING ORDER OF OPERATIONS AND TIME ALLOWANCES.
The original is 6 by 4 inches, thin card, to work in type-writer.

"B" for boring, "B 1" for first boring, "B 2" for second boring, etc., is suggestive of the name of the operation, and gives less liability to error than the straight numerical system. The company has gone very closely into the details of specifying beyond the shadow of a doubt the exact nature of the operation to be performed. As a result it has been found impracticable to attempt to print all operations on a time ticket and check off the one done, as is the practice in some shops. The list of operations comprises about eight hundred and covers all possible operations including fitting and assembling. It is found in practice that there is as little error in posting an incorrect

abbreviation as there is in posting any other number, such as order number, number of hours, etc., erroneously. It is true that the cost cards are not intelligible to parties unfamiliar with the code of abbreviations. This is no disadvantage, as consultation of the records by parties unfamiliar with them is inadvisable in any event, and the information desired can be more quickly obtained by some clerk familiar with the card system.

After having been posted on cards, the time tickets are filed in card-index drawers, according to workman's numbers if time has been set, and according to operations if they are to be used as data in setting time. The duplicate tickets are kept in a separate file and returned to the men with the premium earnings.

920 S. O. 2455			40 Pl. Amt. 12				No. 198
Date	Operation	Wkm.	Hrs.	Rate	Labor		Remarks
8-9	01	47	88	25	22	00	Cr. 2 hrs
	PREMIUM GAIN,		44 2		11	81	Bud. Cost 92
8-11	01	85	6 3	17	1	15	
	PREMIUM GAIN,						
8-14	M. 15	125	18	18	3	24	
	PREMIUM GAIN,		5			45	
	Total Labor,						
	Mtg. Ex.,		112 3	Gordon Rate			
	Material,						
	Total,						

FIG. 5. INDIVIDUAL PIECE-COST CARD.

"No. 198" refers to guide-card number. The actual card is about 6 inches high, and carries eight job spaces, instead of four as here shown.

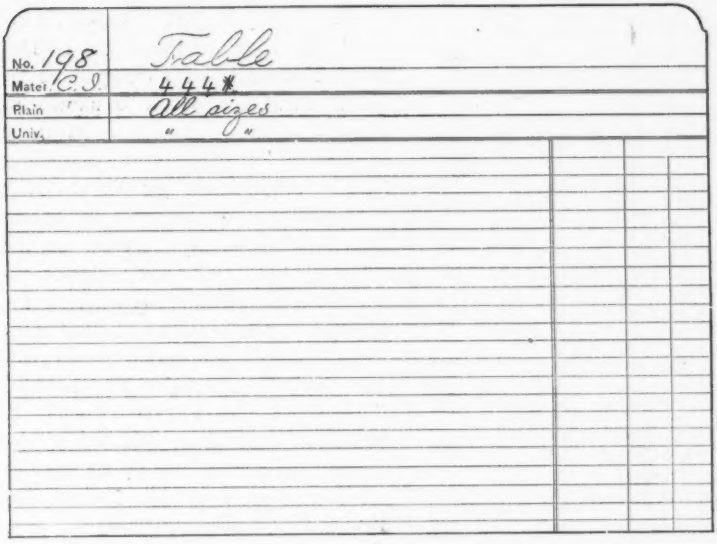


FIG. 6. GUIDE CARD FOR INDIVIDUAL PIECE-COST CARDS.

Blue, ruled in red. 6 by 4½ inches.

A daily report of cost of finished parts is submitted to the superintendent on the form shown in Figure 7. On the alternate lines is given the last previous cost of the pieces.

C. M. M. CO.

Daily Report of Cost of Finished Parts. Date

Shop Order	Name of Part	No. Pieces	Labor	Mfg. Exp.	Material	Total	Remarks

FIG. 7. DAILY REPORT OF COST OF FINISHED PARTS.

Showing headings and ruling. The original is 8½ inches wide and 14 inches high, ruled in red with pale blue horizontal lines.

DETAILED STATEMENT OF DISCREPANCIES

NAME OF PART.	ORDER NO.	NO. PIECES	CHECK NO.	DEPT.	OPERATION	DATE	TIME	DATE	REMARKS
No. 1 Pen Post 24 RH	9275	50	45		3d Slum	3/2	6¼	1/4	
" " " "	2490	50	45		" "	7/28	11¾	1/4	

FIG. 8. DETAILED STATEMENT OF DISCREPANCIES.
This shows the headings and ruling. The actual form is 14 inches wide by 8½ inches high.

The "Daily Report of Cost of Finished Parts," is acompanied by a "Detailed Statement of Discrepancies in Cost," form for which is shown in Figure 8. The company was fortunate in having complete data extending back a considerable period, covering time taken to do the various operations. The example shown on the form in Figure 8, is but a simple example of a prevalent type, viz., the taking of a longer time to do the work when the men are under the impression that they are fixing the standard time, than it took the same men to do the same work under the same conditions when they had no thought of setting the pace. Costs of entire machines are made up periodically from the last costs of the individual pieces.

In establishing the proper order of operations and determining the time allowance, a clerk was employed to note, on the cards representing the various pieces, the operations reported on these pieces. A certain number of these cards with operations noted on them were taken daily to the various foremen, and the operations checked and entered in proper order as far as possible. These lists were finally verified at foremen's meetings. Should there be a change in the sequence of operations decided on, the retired record card is preserved with notations of reasons for changes. This record will simplify any future discussions of the matter since the reasons for the change are preserved in writing.

Amt. 100 S.O. 2445

Size #1 Pl.

Article CAP, 9" DROP HANGER

To be Finished	Material Wanted	Material Received
Sept. 1	Aug. 1	July 25

Inspector	Good	OPERATION	Symbol	Dept.	Time Each
		1 Clean	C	A	
		2 Color	C50	F	2.1
		3 Drill & Tap for Lid	D16	C	3.5
		Over			

WAREHOUSE COUPON

S.O. 2445

Article CAP, 9" DROP HANGER

Material Wanted Aug. 1

Amount 255# ft.

Material C I Size

Date Delivered 7/25

RETURN TO MATERIAL CLERK Jones-

FIG. 9. SHOP-ORDER TRACING TAG.

The original is 8¾ inches high, the extra length being in the spaces for "Operations" in the upper section. The warehouse coupon is detachable at the perforated line as indicated.

In setting time, the time taken to do the work on the particular piece in question was not taken as the only criterion, but the same operation on other similar pieces was also considered. There have been but few cases in which the time as set has been wide of the mark. The average gain in salary by the workmen has been about 10 per cent. per man since the introduction of the premium wage system. At first sight it would appear to an outside observer that a com-

pany using the premium wage system, and reserving for itself one-half the profits of the increased speed in the laborer's work, could earn this one-half of the wages as clear profit. It will however be found that the expenses for the clerical work of accurate cost and time keping are nearly as great as the premium payments, and perhaps greater if the premium system covers only a small portion of

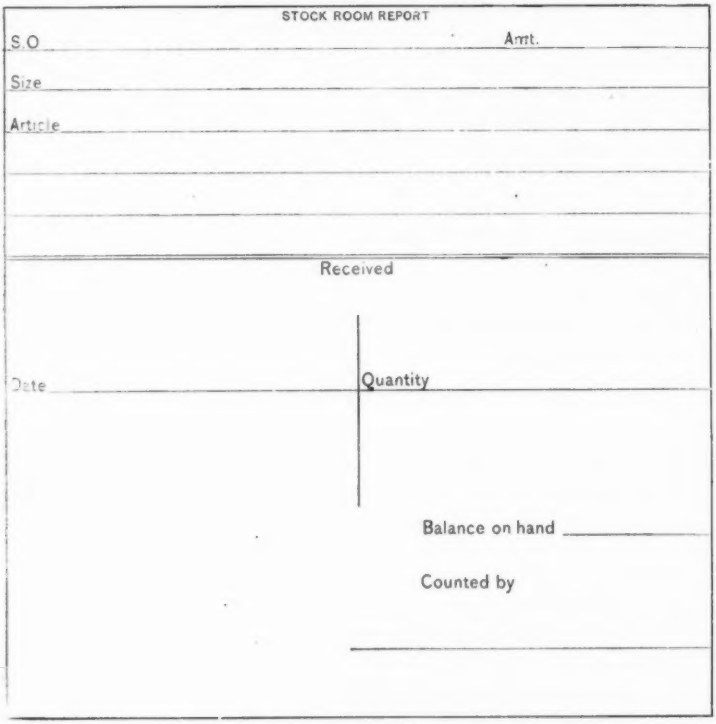


FIG. 10. STOCK-ROOM REPORT.
The original has more height in the lower part, being 4 by 6 inches.

operations. As the system is extended, however, this will not be the case. The management of the Cincinnati Milling Machine Co. are perfectly satisfied with the results in the greater output, and the reduction of the burden rate, to say nothing of the advantages of having the accurate costs of individual pieces and correct records of individual workmen's efficiencies that the system has brought with it.

The shop-order tracing tag is shown in Figure 9. It is printed on

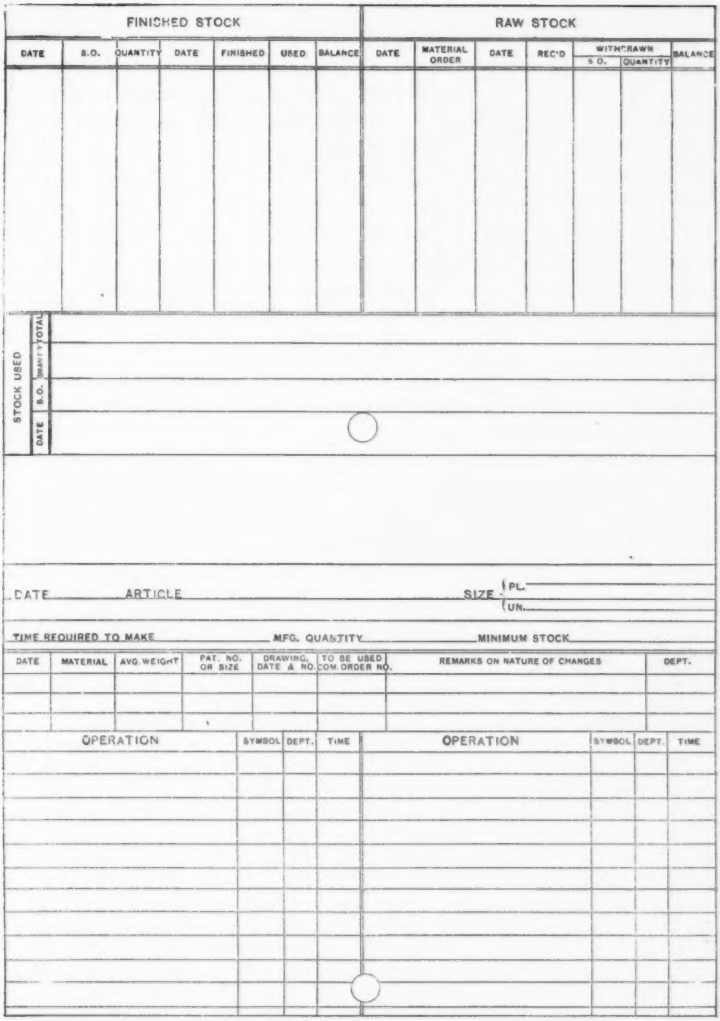


FIG. 11. FRONT AND BACK OF PRODUCTION CLERK'S RECORD CARD.

Original is larger—8 inches wide by 5 inches high. The relative proportions of the various spacings and rulings are approximately preserved in this reduced *fac-simile*.

Amt. S.O.

Size

Article

To be Finished | Material Wanted | Material Received

Inspector	Good	OPERATION	Symbol.	Dept.	Time Each
		Over			

RED TAG FOR RUSH ORDERS.

This card is a bright rose-pink color, and is held by a clip in a tin frame with turned up edges. It is 4 inches wide by 6 high, having 20 horizontal lines in the lower part instead of 6 as here shown.

Inspector	Good	OPERATION	Symbol.	Dept.	Time Each

BACK OF RED "RUSH-ORDER" CARD; FACE IS SHOWN JUST ABOVE.
Original is 6 inches high.

stiff bond paper to permit manifolding on the typewriter. When the raw material is in, the foreman doing first operation on piece receives the tracing tag. When he is ready to start work on it he sends tag with warehouse coupon attached to the stock keeper of the raw-material warehouse, who retains the warehouse tag when he sends the material into the shop, and returns the tag to the shop-order or production clerk. As many manifold copies of the order-tracing tag are made as there are departments to work on the piece, these copies being printed on yellow paper and serving as foremen's notices that the work will be in the shop. These foremen's notices are filed in card-index drawers with chronological guide cards. Each foreman's drawer of notices of work in hand is daily gone over by the tracing clerk.

One manifold copy also goes to the stock room. This copy is shown in Figure 10. When finished parts are all turned in to the stock room this copy is sent to the production clerk with a note of the balance of that part on hand, *by actual count.* Similar notice of balance by actual count is made on the foremen's requisitions for withdrawals, and turned in to the production department. In this way actual count is made daily of from fifty to one hundred items in the stock room. The production clerk's card record from which he issues the order-tracing tags is shown in Figure 11.

The rush-order tracing tag is mounted in a light tin frame (see cut page 588) in order to protect it from dirt and grease, which made the old style of tag (an ordinary shipping tag) illegible in many cases.

The number of men employed in working out the system is as follows:

Time-keepers, two men.

Production department—shop order clerk and assistants—three men.

Stock room, three men.

Cost department, including pay-roll, and establishing of order of operations and setting time, eight men.

It will thus be seen that the total number of men doing work in connection with the system is sixteen.

EDITORIAL COMMENT

WHILE we have always been justly proud of American progress, and fully appreciative especially of that pre-eminent genius for doing things economically and well which is characteristic of American engineers, we have never been among those who thought the whole world was finally won, and foreign engineering enterprise laid captive at the feet of the manufacturers of the United States, because we built some bridges in Burmah, sold machine tools in Germany, or furnished a score or two of locomotives to the British railways. It was all good and gratifying, and it opened vistas of possible expansion which we hope and believe American manufacturers will realize and widen, to their enormous advantage. But the very keenness of activity into which Europe —and especially England—was startled by even the relatively small contracts taken in competition by American bidders, showed plainly that the Old World had been napping, and now thoroughly awakened, would not so readily allow a march to be stolen again.

* * *

IT was indeed, as we have said before, a stolen march—stolen while England slept in the fancied security of her one-time primacy as manufacturer to the World ; but this very sleep gave her a reserve upon which we had been meanwhile drawing—a reserve of unutilized possibilities of better machinery and processes, of unrealized economies in shop-practice, of unapplied margin of output capacity in the worker. We have steadily urged our conviction that England, which lives by foreign trade, would spare no effort nor expense to place herself again in the fore, and that the best of everything that goes to manufacturing success—tools, methods, talent—was open to her adoption or her purchase, while the soundest economic system and the most magnificent commercial and marine development were hers already. Indeed, we have pointed out that many of the contracts taken by Americans were secured either because Britain was too busy already to handle them, or because she was actually equipping herself, through them, to meet and underbid America in future.

Time is bringing proof of the truth of our view. When the present enormous home activity lulls and American machinery makers again seek the saving aid of the foreign market, they are likely to find their competitors abroad far better equipped to meet them with the very weapons which formerly won the victories for the United States. Even now there are signs of changed conditions. Two press despatches of the day tell of British success against "keen American competition"—one in bidding for electric tramways for Lorenzo Marques, and one in a contract for locomotives for the Canadian Pacific Railway. In the former case the English firm "offered to do the work quicker than the Germans and at less price than the Americans"; in the latter the Scotch builders got the contract "because they promised quicker delivery of the engines." This is a defeat on our own ground—low cost and prompt delivery.

Nothing is further fromour thought than to suggest that there is in this any discouragement to American manufacturers from entering the foreign field. We are more than ever convinced that open markets abroad are essential to the security and stability of the American machinery trade. But these facts indicate that manufacturing conditions have been very much evened up—that the foreigner has largely cut down that lead of ours in shop economy by which we formerly offset the handicap of our fallacious political economy.

* * *

For fallacious the American high-tariff system will prove, with increasing clearness as, in the inevitable expansion of trade, the foreign market becomes more essential to the American manufacturer. Britain and Germany have already secured so much as they cared to take of our ideas and our methods, and however highly we may rank American mechanical ingenuity, they are not likely ever again to allow us to gain such a lead in our shops as we had but a few years ago. When it becomes clear, as it must, that with equal opportunities for the acquisition of our ideas, the foreigner can actually buy our machines and our raw materials cheaper than we can buy from one another at home, and with the equipment which we have sold him can compete with us to our own disadvantage on neutral ground, we shall wake as a nation to the discovery that our political economy is as obsolete as England's shop economy was when the "American Invasion" startled her to activity and radical reform. It is our earnest conviction that the American manufacturer will be true to his character for discerning quickly the signs of the times, and prompt in putting his obsolete political economy where the British manufacturer has been so courageously putting his obsolete shop economy —on the scrap-heap.

Although the ostensible object of engineering conventions is the presentation of papers upon professional subjects, it is very well understood that by far the most interesting and valuable portion of the proceedings lies in the discussion which is elicited by the formal contributions. As the Arab proverb has it: "The lesson is one, but the talk that follows the lesson is one thousand." This was clearly brought out at the recent convention of the American Society of Mechanical Engineers, when the papers, previously distributed in print, were in many cases read by title only, or the author was called upon to state in the fewest possible words the salient features of his argument, in order that the discussion might be proceeded with at once. It is to be hoped that this will become the standard practice hereafter, and that the whole effort will be the stimulation to active and vigorous discussion of subjects of present importance.

In order that this most desirable result may be accomplished, there are some features which may be mentioned as bearing upon the success of the meetings. In the first place the papers should be in type much earlier than is now the practice. Many members upon rising begin by stating that they have not had time to look over the paper under discussion, having only received it a day or two before. Busy men, whose opinions and discussions are worth having, cannot choose the time when they will examine the papers, and they should have them in their possession far enough ahead of the meeting to be able to give them attention during the opportunities which may come. It would be well also to have the advance copies of the papers printed upon one side of the paper only, thus giving convenient opportunity for the making of memoranda and notes in form available for use during the discussion. This could

readily be done at the mere cost of the white paper, since the forms are doubtless arranged to be "backed" in the printing office, and the first run could be left unbacked for the advance copies.

If the authors of papers for presentation and discussion would take a little more care in the systematic presentation of their subjects, it would also aid greatly in the discussions. Some writers prepare their contributions in admirable form, but it must be admitted that in many instances most valuable information is presented in a very slipshod manner. A paper should begin with a brief statement of the points which the author intends to make, arranged in logical sequence, and these points should then be expanded in the body of the paper, and followed by a summing up of the whole, in form for ready reference during the active discussion.

Some contributors have adopted the most excellent plan of appending a bibliography of the subject to the paper, thus advising the members of the original sources of their information, but this is of course applicable only to special cases.

The great point to be kept in mind, by author, publication committee, presiding officer and members, is that it is the discussion which is the thing, and that everything which aids in eliciting a full, intelligent, and varied discussion should be encouraged.

* * *

We have commented in these pages at various times upon the weird specimens of scientific (?) and other information which appears in the daily papers concerning technical matters, and ventured mildly to suggest that some degree of modern technical knowledge be included among the other accomplishments of certain members of the staff. Those who have observed the kind of reporters who are detailed to attend the professional sessions of scientific societies can readily realize how such grotesque statements get into print as those to which we refer, and indeed it has become matter for surprise when a really intelligent account of an engineering matter is published in the daily papers.

The latest candidate for the freak scrap book is a remarkable account of the new dam and barrage across the Nile, for the control and regulation of the water for irrigation. Accompanying more than two columns text, mostly irrelevant, one sees an elaborate bird's-eye view of the Nile, from the island of Philæ to the Mediterranean, with the dam at Assouan shown in considerable detail, but with the water distinctly flowing up-stream! A calm and extensive mill pond is shown below the great dam, while through the sluices on the upper side appears a strong current, rushing up to the picturesque island, the dam apparently having succeeded in holding back but a portion of the waters of the Mediterranean. The Suez canal appears as a sort of spillway, permitting any excess of water in the Mediterranean to escape without overtopping the dam in the foreground.

* * *

In the death of Sir W. C. Roberts-Austen the applied science of engineering has lost one of its ablest and most vigorous exponents. Space here forbids extended rehearsal of his many and valued contributions to the union of exact science with practical work, but to the engineer his monument will necessarily be the work of the Alloys Research Committee of the Institution of Mechanical Engineers. That engineers have been taught a vast amount of essential knowledge concerning some of the most important materials with which they must do their work is a consequence of his earnest and busy life, and amongst all his other achievements, this will persist and endure.

REVIEW OF THE ENGINEERING PRESS.
"THE WORLD IS ITS FIELD"

THE METRIC SYSTEM IN AMERICA.

ITS MERITS AND DISADVANTAGES FOR USE BY ENGLISH-SPEAKING NATIONS—THE QUESTION OF COMPULSORY ADOPTION.

American Society of Mechanical Engineers.

PROBABLY there has been no such animated discussion of the metric system by an engineering body as that which took place during the recent convention of the American Society of Mechanical Engineers in New York, apropos of the paper presented by Mr. Halsey upon the subject.

Mr. Halsey's paper was primarily intended to remove a false impression which had become prevalent concerning action which had been taken by the society at a previous meeting, the advocates of the system having misconstrued a resolution intended to refer generally to the work of its committees into an authoritative expression of opinion by the society favorable to the metric system.

In general Mr. Halsey's argument was based upon an analysis of the extent to which the system is really used in countries which are claimed to have adopted it, and he succeeded in showing what every one but a confirmed metric "crank" is fully prepared to admit, namely, that the old units of weights and measures persist to a marked extent by the side of the new, and in many instances remarkably mixed up with them. It was made altogether clear to the impartial listener that the official "adoption" of the metric system by any country is not successful in insuring a complete transfer of usage from the old to the new, and indeed, as Mr. Halsey put it, the existing systems are "irrevocably tied to the past."

While this is doubtless true, it is also true that the past is past, and is constantly growing further from us, and there is no doubt that old methods and old systems do die out when there is no further use for them. It is also true, however, that the life and persistence of any system depends upon the strength and activity of the people using it. In other words, it is not in the system itself that the vitality lies, but in the commercial and industrial strength and activity of the nations using it. Many of Mr. Halsey's examples are taken from the usage of countries of no commercial or manufacturing consequence, and it is but natural that they should be found using the units of the various nations from which they procure their manufactured articles, mingled with their own old and indeterminate units.

So far as the discussion at the meeting is concerned, it was principally occupied with the question of legislative action to enforce the use of the metric system. The bill which was introduced at the last session of Congress, and which will doubtless be attempted again, is nominally intended to refer only to the work of the various departments of the government, compelling all of them, *except the land office*, to use the metric system in all their work. It is significant that this discussion was thought of sufficient importance to attract the attendance of Director Stratton, of the bureau of standards, and Mr. Southard, the chairman of the house committee of coinage, weights and measures, and that both of the gentlemen accepted the privilege of the floor to advocate the purpose of the bill. Curiously enough, both of them assumed the

defensive position altogether, and devoted themselves to explaining that the bill did not mean anything to the engineering profession, and was intended only for the furtherance of the work of the departments of the government. Mr. Southard, indeed, assumed to act as an interpreter of the bill, although the members of the society well understood that if the bill should become law its interpretation would be in the hands of the courts, in spite of any assurances which a member of Congress might previously have given. As a matter of fact the bill does contain the words that after a certain time the metric system "shall become the legal standard of the United States," and it must remain with a higher court than the mere verbal opinion of a member of Congress as to what is meant by those words. Mr. Southard said that the government thought it would be a good plan to try the system upon the government departments first; "trying it on the dog," as he termed it, but when pressed to explain why the operations of the land office had been especially excepted from the action of the bill he explained that so much of the work of that office had been done under the old units that it was thought best to leave them out of the action of the bill. The condition of the land office resembles so closely that of most of the large manufacturing industries of the country, that it is respectfully suggested that that department of the government's work would be the best "dog" which could be found upon which to try the experiment, and one of the strongest arguments which could be brought against the sincerity of the government's position in the matter is this exception in favor of a department in which some trouble would be made for the men concerned. If the bureau of standards and the committee on coinage, weights and measures are really sincere in their desire to use the government as an experimental means of obtaining information, let them do two things to the bill; omit the indeterminate expression "shall become the legal standard of the United States," and include the work of the land office in its action.

So much has been said about the metric system itself, that there is little which can be added here. Nevertheless, it may be permitted to call attention to some points in that connection which are too frequently glossed over. It is well known, and apologetically admitted, that the meter bears no definite relation whatever to the dimensions of the earth, but is merely an arbitrary length of a master standard preserved in Paris; but it is not so generally made public that the true length of this standard is not yet precisely known, but that it is even now the subject of the research of the commission for the verification of the meter, constantly engaged in the pavilion of the International Bureau of Weights and Measures at Breteuil, near Paris. The advocates of the system also keep very quiet about the fact that the kilogramme is not the weight of a cubic decimeter of water, but that it is really only the weight of a piece of platinum of indeterminate density also the present subject of investigation and research. Thus the much-vaunted interchangeability of the units of dimension and weight, so constantly used by metric advocates, is not true, much as they use the statement to the contrary.

The chief argument for the metric system is that it is a decimal system, but there are many very practical men, and many trained mathematicians who deplore the existence of the decimal notation in the present system of numeration, and look upon the enforcement of the decimal metric system as a thing to be opposed as delaying the abolition of decimals by the supercession by a better system.

The only real argument which can be logically advanced for the metric system was that made by Mr. George S. Morison at the meeting above referred to, the importance of securing uniformity throughout the civilised world. No matter what the system is, the important thing is that everybody in all nations shall use it. This is true in a superlative degree, but it is not to be accomplished by legislation. It is not so many years ago that French was the language of commerce over the industrial world, but it has rapidly made way for English. In like manner the system of weights and measures which the English-speaking nations see fit to use will also predominate. In spite of the fact that Germany officially adopted the metric system more than thirty years ago, every German vessel still rates its displacement in British tons, its speed in British

knots, and its draught in British feet. This is but the natural result of the predominance of Great Britain in all that relates to shipbuilding and commerce. With the United States and the British Empire joining their work by the bonds of a common language and a common system of weights and measures, the predominance of that language and that system is assured in all parts of the world.

MODERN AUTOMOBILE VEHICLES.

MOTORS, RUNNING GEAR, IGNITION, FUEL, AND GENERAL OPERATIVE DETAILS—BRITISH AND CONTINENTAL PRACTICE.

Messrs. Lavergne, Longridge, and Forestier.

THREE notable papers have recently appeared treating of the development of the modern automobile, and the general interest at present existing in the question renders it expedient to review them at this time together. The long paper of Captain C. C. Longridge, presented before the Institution of Mechanical Engineers attracted much attention and discussion, while in France the series of papers upon the status of the automobile in 1902, contributed to the *Revue Générale des Sciences* by M. Gérard Lavergne, and the review of the whole subject of automobile construction by M. G. Forestier, in the *Annales des Ponts et Chaussées*, complete the latest word upon the subject.

Captain Longridge gave his paper the somewhat misleading title of "Oil Motor Cars of 1902," while as a matter of fact he treated almost entirely of vehicles propelled by motors using the light volatile essence, petrol, or gasoline. Some day it is to be hoped that a fully satisfactory motor using heavy oil directly without preliminary vaporisation will become an established fact, but as yet there appears to be nothing of the sort available for motor vehicles. Both Captain Longridge and M. Lavergne agree that there has been little improvement in motors since the early machines of Daimler, except in minor details of construction, and in reduction in weight. In this latter respect some of the French makers have made material progress; thus, the 16 horse power Buchet motor used by Santos-Dumont in his dirigible balloon weighed but 5.8 kilogrammes per horse power, while the Centaure motor of 70 horse power made by Panhard for the Paris-Vienna competition weighed but 4 kilogrammes per horse power. Weights of 7 to 8 kilogrammes per horse power are common.

The question of speed regulation continues to be an important one. Although all the vehicles equipped with internal-combustion motors are provided with clutch gearing permitting several changes in speed for one speed of motor, this is not sufficient for road purposes, and something more must be provided. Various methods are employed for the direct regulation of the speed of the motor. The charge of fuel entering the cylinder may be throttled, or the exhaust may be choked. The latter method is maintained to be the more economical, since the most efficient charge-mixture and volume may be left undisturbed. The ignition may also be delayed, this being an effective, though wasteful method. M. Lavergne calls attention to the fact that the recent powerful four-cylinder motors are so arranged that one or more cylinders may be cut out of action at will, this, in combination with the clutch gear mechanism, giving a range of speed variation which rarely requires any modification in cylinder action to be made. Ultimately it is possible that some form of variable speed gear may be designed which will permit the motor to be operated at full speed and power while the speed of the vehicle is controlled altogether by the gearing. This is especially desirable as permitting the maximum power to be used for a slow speed of the vehicle, a matter sometimes most useful.

While the greater part of all the papers referred to is devoted to vehicles propelled by internal-combustion motors, yet other types receive some consideration. Thus M. Lavergne discusses the latest forms of Serpollet steam vehicles at length, and shows the detailed improvements which have been made. Indeed it might almost be assumed that the Serpollet machine holds a position

midway between the gasoline and the steam vehicles. The motor is much more like an internal-combustion engine than a steam engine in design, while the coil boiler, with its instantaneous generation process produces a fluid more like gas than steam. The excellent performances which are on record for the Serpollet machines have given them much greater prominence in the automobile world than other steam-propelled vehicles, steam otherwise being used principally with the light runabouts of American origin.

It would appear that the possibilities of the steam turbine for motor vehicles had not yet received the consideration which they deserve. The high speed at which a turbine of the de Laval type is run, for example, renders it light in weight for the power developed, while the steam economy is materially higher than that of small steam engines of ordinary forms. The entire absence of vibration is a feature to be considered, and altogether it would appear that the turbine, in combination with a suitable form of speed reducing and regulating gear would prove an appropriate form of motor for steam vehicles.

Captain Longridge devotes much attention to the possibility of using water spray in the cylinders of internal combustion motors for cooling purposes, and the experience of Banki with this method for stationary motors makes the suggestion feasible. The general feeling that cast iron is an unsuitable material for cylinders and that steel should be used, renders it desirable to provide some effective method for cooling in place of ribs cast upon the cylinder, and the use of internal water cooling with tool-steel cylinders appears to be a matter for consideration and experiment.

It is most interesting to perceive how the motor vehicle has become one of the most important subjects for discussion among engineers, thus forming at the same time a matter for science and for recreation. Ultimately there is little doubt that the motor-vehicle industry will take its place as one of the great manufacturing occupations of the industrial world, ranking with locomotive and steamship building, since the machine must supersede the animal over the entire world. It is well, therefore, that it has thus early come into the hands of the engineer, and that he will prove equal to its solution no one can doubt.

THE UTILISATION OF NATURAL RESOURCES.

AVAILABLE STORES OF MATERIAL IN TIMBER, COAL, OIL, AND PEAT, AND OF POWER IN FALLING WATER.

Presidential Address—Institution of Civil Engineers.

IT is extremely appropriate that the subject of the address of a president of the Institution whose members are devoted to the "art of directing the great sources of power in Nature for the use and convenience of man" should be a review of the present and future stores of available natural resources. Mr. J. Clarke Hawkshaw, in his presidential address before the Institution of Civil Engineers has done this in a manner both profitable and interesting, and from his address we make some abstracts.

Few people realise the quantity of timber used in engineering work, many believing that the present age of steel has relegated wood to a second place as a material of construction. Mr. Hawkshaw shows that the imports of wood into Great Britain exceed in value her total production of pig iron. For the one purpose of railway sleepers wood is extensively used, it being estimated that there are in use nearly 1,500 million sleepers, of a value of 180 millions sterling.

In many parts of the world wood is extensively used for fuel, and unlike coal, it may be made a fuel which is self perpetuating.

It is true that the great virgin forests of the tropics are not now available for lack of proper transport facilities, but it must not be forgotten that these regions may and doubtless will yet become the dwelling places of civilised and industrial nations, capable and desirous of utilising these stores of Nature's resources.

At the present time, however, the cost of coal, in most countries is the important element in the cost of iron and of power.

Notwithstanding the great advance in mining processes, tending to lessen the cost of production, the price of coal is more likely to rise than fall in years to come. At the same time there are supplies in other parts of the world to be considered.

"Many thousands of million tons still remain of the world's store of coal. China has an enormous supply as yet almost untouched. In one province alone, that of Shan-si, it is said, there is coal equal to our present yearly output for 3,000 years. There is coal to meet the world's requirements for many years to come. Even if this were not so, the world is no longer so dependent on fuel now that we are again calling on falling water to aid us in our work, as it was when our forefathers first tried to apply the forces of Nature to the use of man.

"We cannot estimate the total power which the water falling on the earth's surface would produce in its descent to the sea; but we can form some idea of the limits within which it would lie. Assume a depth of 10 in. of rainfall to flow off each square mile of land surface, the mean height of which may be taken as 2,250 ft. above sea-level. Then water from the whole surface falling through the mean height would give 10,340 million horse-power in perpetuity. Our present yearly output of 225 million tons of coal would only give that amount of horse-power for little over half a day.

"It is estimated that 263,000 horse-power could be supplied by the larger rivers of Norway south of Trondhjem without regulation; by regulation the power would probably be quadrupled.

At one of the falls on the Glommen, where there is 45,000 horse-power available, a power-house is now being erected, from whence the power will be transmitted to Christiana.

Germany, Austria and Switzerland have made larger use of water-power for industrial purposes, and in some cases for working railways.

France uses water-power to the extent of 500,000 horse-power already.

Italy is making use of her waterfalls, transmitting power to a distance of 62 miles on Lake Como for railway and other uses.

It is, however, in the United States that most progress is being made in the electrical transmission of water-power. Forty-three companies, having a total capacity of 132,330 horse-power, transmit power for a total distance of 1,549 miles, on an average 30.3 miles, with a voltage which varies from 10,000 to 50,000. The maximum distance to which power is transmitted is from Colgate to San Francisco, 220 miles, with a loss of 25 per cent."

"Africa, with its four great rivers and notable waterfalls, has a vast amount of water power in store for the future. Notwithstanding the requirements for irrigation, some water should be available for power at Assouan. Above the first cataract are six more, and further south are the Murchison Falls, where the Nile descends 700 feet in from 10 to 15 miles. On the Zambesi there is the Victoria Fall, which will soon be accessible by rail. Its height is 420 feet, more than two and a half times that of Niagara. At Stanley Pool, on the Congo, Stanley estimates the discharge when the river is lowest at 1,436,850 cubic feet a second—more than four times the maximum discharge at Niagara."

Apart from coal and from water power, however, there are other sources of fuel energy.

"The world has yet another supply of fuel in mineral oil, which, being liquid, is one stage in advance towards combustion. It has many obvious advantages as regards cost, economy of space and handling, etc., especially for steamships, as was shown by Sir William White in his address at Dover, in 1899, saving stokehold staff and weight, which, for an equal evaporation, was put, he said, as low as 30 per cent. of the corresponding weight of coal. It is used exclusively on the river fleet of steamers on the Volga, and, to some extent, by the Russian, German and Italian navies. On the South Caspian Railway, 1,600 miles in length, no other fuel is used. In the United States the South Pacific Railway has 300 engines fitted to burn oil, and its use on railways in America is extending. In this country, the Great Eastern was the first railway to burn oil fuel on a large scale, and others of our railways are following the example of the Great Eastern. New sources of oil supply are continually being discovered, but the uncertainty of supply is the

difficulty in the way of its being adopted on a larger scale for steamships, for which it affords such obvious advantages.

"There is another reserve of fuel in the world in the form of peat. The most productive area for it is the North of Germany and the adjoining parts of Denmark and Holland. In Friesland there are bogs 1,500 square miles in extent, and Germany has more fuel in peat than in coal. A square mile of bog 10 ft. deep contains peat equal in heating power to over 300,000 tons of coal. Ireland has a million acres of large bogs from 10 ft. to 30 ft. deep. The bog of Allan alone has an area of 372 square miles, with an average depth of 25 ft. In Sweden, where peat is more largely used than in other countries, a Crown peat engineer has been appointed. It is estimated that the bogs would yield an equivalent of 3,000 million tons of coal. In Central Sweden as much as one million tons of peat are prepared annually, mostly for metallurgical purposes. For years it has been used in Martin steel and glass furnaces. In Finland, Russia, and Germany locomotive boilers are fired with it. It is now proposed to use peat fuel for electric power stations in Germany. It has been manufactured for fuel for many years, and much ingenuity has been displayed in devising machines for preparing peat fuel. In Germany peat pulp has been treated like paper pulp, being delivered in thin sheets on rollers to drying cylinders. Briquettes made in this way have not much less heating power than coal."

There has been a disposition of late to assume that we are recklessly wasting the resources of Nature, and that with the burning up of the available coal resources a state of barbarism will once more be upon us. In the face of such a view of natural resources as is given in the address of Mr. Hawkshaw we may feel confident that before any one form of stored energy is exhausted others will be found more convenient and efficient.

Wood may always be cultivated, waterfalls lose none of their life by utilisation, while the heat of the sun and the movements of the sea are as yet not directly touched, so that it is altogether too soon to begin to fear any exhaustion of Nature's stores. What may well be feared is that existing sites of industry and power may be shifted to other parts of the world, but it is altogether possible that a realisation of some such changes might go far to break down the present arbitrary and artificial boundaries of nations.

THE TESTING OF INDICATORS.

METHODS OF DETERMINING THE ERRORS OF INDICATOR SPRINGS AND OF MAKING CORRECTIONS IN THE DIAGRAMS.

E. Roser—Verein Deutscher Ingenieure.

So much reliance has necessarily to be placed upon the accuracy of the diagrams produced by the steam engine indicator that it has come to be recognized that in all determinations of magnitude or importance the instruments used should be carefully calibrated. It is then possible to apply the necessary corrections to the diagrams which may have been taken, or to adjust the instrument so that the principal sources of error may be eliminated.

In a fully illustrated paper in a recent issue of the *Zeitschrift des Vereines deutscher Ingenieure*, Herr E. Roser examines the various methods used for calibrating and adjusting the springs of indicators, and as he gives the practice of some well known experts and investigators, his paper possesses a peculiar value for all who are interested in this especial branch of steam engineering.

As is well known, there is generally a certain amount of lag in the movement of an indicator spring, so that if lines are drawn at equal intervals by the pencil on the ascending movement they will not always agree with lines drawn at similar pressure intervals on the descent of the piston. These variations are not always the same for instruments of different construction, besides which the errors due to the influence of heat upon the elasticity of the spring, together with other variations, render it especially important that every indicator should be calibrated before it is used in any important investigation.

Herr Roser has gathered descriptions of the testing apparatus used by such investigators as Professor Slaby, of the Charlottenburg Technical High School, Professor Bach, of the Technical High School at Stuttgart, M. Walther-Meunier, and others connected with the official inspection of steam machinery, and hence his paper possesses a peculiar value for all interested in steam engineering.

Naturally the methods of testing the springs as well as the accuracy of the multiplying lever system which first suggests itself is that of direct weighting, and Herr Roser shows apparatus for this purpose as used by several investigators. The general design of these appliances may readily be understood. The indicator is clamped to a suitable bracket, in the inverted position, and a rod inserted through the steam opening so as to bear upon the piston. By means of a yoke carried on this rod any desired direct weighting may be applied and the corresponding position of the pencil point recorded upon a sheet of paper on the drum. A reversed apparatus serves to test the springs for vacuum. Such devices may be used either to record the deviation from equal movements for uniform loadings, or show the variation in loading required for equal pencil movements.

It is evident that the testing of indicators in this manner does not vary materially from the calibration of any type of spring but in the case of the indicator it is very desirable that all the working conditions of the instrument shall be reproduced. For this reason various devices have been made for testing the springs under the action of steam, in order that the temperature correction may be included.

In testing indicator springs under steam it is not sufficient to reproduce the temperature of the working pressure of the steam in the boiler. It has been demonstrated that the temperature of the interior of the indicator cylinder is always lower than that due to the maximum pressure indicated, this difference varying with the point of cut-off, and with the extent of leakage which is permitted past the indicator piston. Thus, for a pressure of 5 atmospheres, for which the normal temperature is 158°C., the temperature in the indicator is found to be only 96°C., or less than the boiling point, while for a pressure of 15 atmospheres, with a corresponding steam temperature of 200°C., the temperature in the indicator reached but 148°C. In the case of a piston which leaked sufficiently to permit the steam to pass it with comparative freedom the temperature in the cylinder approached more nearly that due to the pressure, while in the case of superheated steam it is found that with steam temperatures between 250° and 350°C., the corresponding indicator temperatures are 150° to 170°C.

It is therefore necessary to provide any accurate testing apparatus with some independent method of determining the true temperature of the spring, instead of assuming it to be the same as that of the steam supplying the pressure. Another method, used by Professor Slaby, in his elaborate indicator testing plant at Charlottenburg, is to provide the pressure by a mercury column and pump, independently of the steam used for warming the instruments, thus providing altogether separate sources of temperature and pressure.

It is generally understood that in nearly all forms of instruments of precision, it is almost impossible to obtain extreme accuracy, while it is altogether possible to determine instrumental errors very precisely, and thus enable the corresponding corrections to be made in the observations. Absolutely correct instruments are not made, but the errors or the variations from extreme accuracy may be determined and the proper corrections so made that the final results may be brought to an approach to the truth known to be within certain limits of probability. It is, however, much easier to make corrections for instrumental errors in a series of recorded and tabulated observations than it is to correct a continuous diagram, such as is drawn by an indicator pencil.

For purposes of power measurement it is generally the area of the diagram which is required, and if the scale of the spring for various portions of its travel is not constant, it is evident that any attempt to measure the area as a whole by the planimeter will not give the true mean effective pressure throughout the stroke.

Various methods may be devised to overcome this difficulty, these being based on the division of the diagram into several

portions, in each of which the scale may be assumed to remain constant. Each of these portions is then measured separately, using the corrected value of the scale belonging to each, the sum of the several portions being taken as the corrected area of the whole. By using the corrected values for various portions of the range of the spring movement it is also possible to find points in the curve corresponding to the corrected pressure for determinate points in the stroke, and thus a critical examination of the action of the steam at any point in the cylinder may be made.

When it is considered that the indicator diagram is often used for the measurement of power for engines in which the effect of the steam upon a piston several feet in diameter is referred to the action of an indicator piston of about half-an-inch in diameter it will be seen how essential it is that the limit of error should be made as small as possible. The engineer is working at the short end of a very long lever, and every error in the instrumental work is multiplied many times. Herr Roser's paper will be accepted as an excellent contribution to methods which are rendering the work of the steam engineer as precise as that of the chemist or physicist.

SUBMARINE TORPEDO BOATS.

THE DEVELOPMENT OF VESSELS FOR SUBMARINE WARFARE IN EUROPEAN AND AMERICAN NAVIES.

Society of Naval Architects and Marine Engineers.

THE success which has attended the trials of the submarine boats "Moccasin" and "Adder," the first of the fleet of the Holland boats now under construction for the United States Navy, lends additional interest to the paper of Mr. Lawrence Spear, recently presented before the Society of Naval Architects and Marine Engineers upon the general subject of submarine torpedo boats.

After a general resumé of the historical side of the subject, Mr. Spear proceeds to consider the present status of the submarine, and considers that three nations only, France, Great Britain, and the United States need be considered as beyond the experimental stage.

France, earliest in the field with "Gymnote" in 1886, now has 44 boats built, building, or provided for; Great Britain has 10, and the United States 7 boats.

The original idea of such boats was that of the pure submarine, constructed with but one form of motive power, this being intended both for surface and for submarine propulsion. The necessarily limited radius of action of any form of power suitable for submarine propulsion led to the design of the so-called "submersible" boats, in which a separate power installation for propulsion on the surface is provided, this power also being available for charging storage batteries for use while submerged. This improvement has resulted in greatly increasing the radius, rendering the boat independent of a base so far as power is concerned, and diminishing the risk of disability.

Concerning the modern French submarines, exact information is naturally not always available, but Mr. Spear has given in the main quite correct ideas as to their general construction. At the same time he is not quite up to date in assuming that the French Marine is committed to the use of steam engines, with kerosene fuel for the principal source of motive power, since it is a matter of exact information that the Minister of Marine is interested in the adaptation of a special form of internal combustion motor, using heavy oil direct in the cylinders, as a source of power for the latest submarines.

Apart from the mechanical details discussed in Mr. Spear's paper, there are some points in recent work which may bear upon the success of the problem which he has not mentioned in detail.

Thus it is altogether possible that the use of sodium peroxide may be found a far from efficient method of purifying the atmosphere of a submerged vessel than the use of flasks of air or of oxygen. The experiments of Desgrez and Balthazard show that the use of tablets of the peroxide, dropped into water as required, will replace

the consumed oxygen readily, while the released sodium absorbs the carbonic acid, so that there is little difficulty in maintaining a respirable atmosphere for any reasonable length of time.

Again, the difficulty arising from the liberation of explosive gases by the electric storage batteries may be overcome by the use of batteries of the Edison type, in which the electrolyte is not decomposed, and hence evolves no gas. These features may readily be applied to existing submarines without modification, while the substitution of a motor burning heavy oil directly in the cylinder, instead of the volatile and dangerous gasoline, a question already considered by the Holland people, must surely appeal to the engineer as the true solution of the problem, and it is to be hoped that the United States will not let France get ahead of her in this important particular.

The most important portion of Mr. Spear's paper is that in which he foreshadows the developments of the future, with especial reference to the work in France and in the United States; and from his conclusions we make some abstracts.

"Confining ourselves at present to the submersible type, we note that the French and American designs, though independently worked out, are identical as to general principles and close to each other in the main features of design, the difference in the aims of the designers being taken into account. The distinguishing features as submarines are, first, reserve buoyancy, and second, control in the vertical plane by rudder action only.

"The presence of reserve buoyancy undoubtedly increases the difficulty of securing complete and satisfactory control in the vertical plane, as no matter where located it introduces an upward force which requires balancing, and it may, in addition, introduce a turning moment about the center of gravity which also requires balancing. Its advantages, however, entirely justify its presence, since it not only serves as an instantly available element of safety in an emergency, but also permits the submarine to maintain the awash condition whether underway or not, without change of ballast or direct expenditure of power. In this condition, ready to dive instantly, presenting only the conning tower as a target, and herself commanding a complete view of the horizon, the submarine will do a great part of her work, even in the event of the perfection of observation apparatus for use when submerged. It is safe to conclude then that this feature has been permanently adopted.

"The second characteristic, viz., control in the vertical plane by rudder action only, is also fully justified by tactical and construction reasons. It is obvious that a change in depth can be effected in the least time and by the least expenditure of energy, if the vessel be moved in the direction of least resistance: in other words, if she be steered up and down inclines by altering the angle of her longitudinal axis to the horizon. In order to be effective, the turning moment used must be of considerable magnitude and under the most sensitive control, conditions best met by horizontal rudders, which have also the advantages of simplicity and economy of space, weight and power. Other things being equal the rapidity with which a submarine can rise for observation and dive again is a direct measure of its efficiency, since its chance of escape from observation or projectiles is in inverse proportion to the period of exposure. As pointed out below, a loss in this quality may be justified when balanced by a corresponding gain in the equally important tactical feature of speed, but in no other way; hence it may fairly be concluded that this feature also has come to stay."

Mr. Spear says, very truly, that the general design of a submarine must be limited by the geographical conditions of its use. France naturally desires boats which shall be not only defensive, but also offensive, and has therefore adopted forms of considerable displacement, great length in proportion to beam, double hull, with large tank capacity, together with the use of the steam engine and multiple rudders. We have, however, already observed, that the latest French designs include one of the latest forms of internal-combustion engines, using heavy liquid fuel directly in the cylinders. With France the possible enemy is within easy striking distance, and offers vulnerable points in the form of large ports and arsenals.

"Turning now to the United States, her

location with respect to possible enemies is such that there is no immediate prospect of the development of the large submersible into an offensive weapon, still the extent of her coasts, the number of her harbors, and the rudimentary character of her fixed defenses, renders this type preferable to the pure submarine for defensive purposes. The development of the best all-round boat to meet the conditions is likely here also to lead to some increase in total displacement, which, eventually however, will probably not exceed 200 tons. As compared with the larger offensive submersible, such a vessel would be less seaworthy and would have less surface speed, better manœuvring qualities and greater submerged endurance.

"To sum up it appears that the submarine boats of the near future will naturally divide themselves into four types and two main groups, to conform to the different conditions in the different maritime countries. Group 1 would be suitable for many of the European countries, and would include the large offensive submersible, self-supporting, with auxiliary bottom working features, and the small defensive submarine for torpedo work only. Group 2, suitable for the United States and similarly situated countries, would include the small offensive ground working submarine or submersible (with auxiliary armament) and the medium sized defensive submersible for torpedo work only. It appears, further, that the submarine qualities of the modern boats are based on sound principles, and that the future development of the four different types within the limiting displacements of each must be along the present lines, and in the direction of improvement in the tactical qualities of speed and practical radius of action. As pointed out above, improvements in these respects are largely dependent upon the general improvement of the power installations, and as compared with the corresponding feature in the battleship, the improvement in the submarine bids fair to be the more rapid."

ENGINEERING AND BUSINESS.

THE RELATION OF ENGINEERING TO THE DEVELOPMENT OF COMMERCE AND THE PRODUCTION OF WEALTH.

Sir W. H. Preece—Society of Arts.

THERE is a constantly increasing evidence that engineering is becoming more and more closely related to the science of business; or, more precisely, the relation between engineering and successful business is being more closely appreciated than ever before. This is demonstrated, not only by the interesting address delivered before the Society of Arts, by Sir W. H. Preece on the Science of Business, but also by the comments which that address has caused in the technical and scientific press.

Considering the first business as reducible to a scientific system, Sir W. H. Preece shows how its operation may be reduced to certain definite laws, these being broadly divided into those relating to revenue, and its relation to capital, and to expenditure and its relation to revenue. These may then be subdivided, and discussed from a business standpoint, the whole forming a comprehensive scheme of much interest from a purely commercial standpoint.

From the position of the engineer, however, the more important portion of the address is that which deals with the application of the scientific principles to what may be termed engineering businesses; those selected in the address being the industries of water supply, gas works, railways, and telegraphs, the latter including submarine cables and telephones. These industries are examined by means of graphical diagrams of the type commonly used in studying the action of physical forces, and already coming into use for the representation of financial and other business relations.

Considering these industries as in operation in Great Britain alone, Sir W. H. Preece shows by means of diagrams how the water supply of London has been conducted on sound scientific commercial lines, and hence has proved most successful, from a business point of view. Similar diagrams applied to gas supply show that it has proved profitable when managed according to sound scientific principles.

Curves drawn from the data of British railways indicate, that the business is in an unsatisfactory condition, and also show in some respects wherein the defects lie. While the capital is increasing, and the growth of traffic is satisfactory, the rate of growth of revenue is stationary, and the difference between expenditure and revenue is diminishing. The cause for this is found in the manner in which Parliament legislates for the railway world without the least regard to the science of business or the ordinary requirements of commercial prudence. When to injudicious legislation is added the difficulties with labour unions, as well as the expensive and unremunerative competition, sufficient cause may readily be found for the condition of British railways.

In regard to telegraphs and telephones, Sir W. H. Preece may certainly be considered as speaking with what may be termed "inside information." He shows the government telegraphs to be in a most prosperous condition, indicating steady progress and financial prosperity, and the same is true of the General Post Office. The telephone business, however, is in a state of chaos, and the only remedy to be suggested is for the government to take it over wholly.

In the light of these examples certain deductions may be made as to the distribution of profit, these including the extent to which provision should be made for depreciation, renewals, reserve, and redemption or sinking fund, before any allotment for dividends may properly be made. Sound finance means a proper appreciation of all these elements, and a due and proper allocation of a portion of the annual revenue to meet each requirement.

It is these points that the difference between sound and unsound management lies. In nearly all manufacturing businesses the determination of these relations are matters of engineering as well as finance. The layman can see no sound business sense in scrapping a tool, which to all appearances is in perfect condition, and working as well as when it was bought, neither can he see the necessity for a heavy annual depreciation of a plant in which the greater portion of the capital stock is invested. The engineer, however, knows full well that the seemingly perfect tool cannot possibly compete with the newer automatic machines in use by rival establishments, and he likewise sees that the only real commercial value in the entire plant lies in driving it at top speed to its finish while it is yet in the forefront of efficiency, earning its own full depreciation within its own limited economic operative life.

Sir W. H. Preece well says:

"The value of scrapping is not appreciated in England. In America, when a new process is introduced, which effects considerable economy in production it can be shown by simple calculation that it is wise and commercial to sweep away the old plant and install the new; and this is done. English manufacturers are most tenacious of old machinery. I have seen old Boulton and Watt machinery at work that absorbed annually an excess of coal and oil costing sufficient money to have justified its removal a generation ago. But it is in the increased rate of production that justification for scrapping comes in. The American does not wait until a machine is worn out before condemning it. As soon as he realises the fact that up-to-date machinery will save him in time and labour enough to justify new plant, away goes the old plant, and the value of the new is soon repaid by the greater production. In the majority of cases the 'betterment' of machinery is charged against revenue, but it is easy to justify its charge against capital if the value of the increased production exceeds the sum of the capital invested in the old and the new plant. However, the judicious manufacturer should be fortified with a reserve fund to provide against antiquation and provide for betterment."

In all the interesting points brought out by the address we see the impress which modern engineering methods are making upon business and commerce, and it is a question whether the engineer in many ways has not proved himself to be a better man of business than the old time merchant. An important feature in engineering is that to a great extent the engineer is able to control the things with which he works, instead of merely adapting himself and his work to outside influences.

The old business maxim was that success lay in buying cheap and selling dear.

To this the engineer brings the ability to buy cheap and so handle the purchase that it can be sold dear, thus extending immeasurably the scope of the merchant who had to find his markets instead of making them. The faculties which are demanded to make a successful engineer, are in the highest degree those which are needed in the successful man of business, and the business man who does not know something of the methods by which the world's work is done is at a manifest disadvantage. Indeed this is so far appreciated that many successful men are realising that a technical education is a far better preparation for business than the academic and classical training of the schools and universities, although the student may have no occasion whatever for the direct use of an engineering education. Beyond all doubt the business man of the future must be a man of science, of that applied science of which engineering is the most conspicuous example.

THE REGULATION OF ENGINEERING PRACTICE.

ADVERTISING AND THE SEEKING OF PROFESSIONAL WORK AND OPPORTUNITIES FOR ADVANCEMENT.

Institution of Electrical Engineers.

ARTIFICIAL restrictions upon the development of a scientific profession have always had their advocates, these ideas being doubtless a relic of the early times when all learning was confined to the priesthood and to secret organisations, but modern civilisation is rapidly outgrowing such mediaeval notions. Occasionally, however, the old disposition to create an artificial exclusiveness crops out, as in the case of the recent circular issued by the Institution of Electrical Engineers. This document, which has been sent by the Secretary to the clerks of certain municipalities and counties, understood to be in the market for professional work, is of sufficient interest to be given in full.

"As it has come to the knowledge of the Council of this Institution that in several cases consulting engineers have applied for employment and in others local authorities have advertised for consulting engineers, I am instructed by the Council to forward a copy of the code of etiquette in such matters that, in their opinion, ought to govern all those belonging to the Institution.

"I am also instructed to urge upon you the great importance of having electrical work well done at the most moderate outlay; and would point out that by advertising, or by employing those who solicit employment either directly or by agents, local authorities may deprive themselves of the services of electrical engineers of high standing and great experience."

STANDARD OF PROFESSIONAL ETIQUETTE FOR CONSULTING ELECTRICAL ENGINEERS.

As approved by the Council of the Institution of Electrical Engineers, July 16th, 1902.

1.—No consulting engineer should solicit employment as consulting engineer verbally, by letter, by agent paid by commission or otherwise, or by any other means.

2.—No consulting engineer should answer advertisements for consulting engineers.

3.—No consulting engineer should advertise for employment.

4.—No consulting engineer should pay by commission or otherwise anyone who introduces clients.

5.—No consulting engineer should receive trade or other discount, or surreptitious commisions or allowances in connection with any works which he superintends.

6.—A consulting engineer who is also directly or indirectly interested in any contracting or manufacturing business should inform his client in writing what his connection is with such contractor.

There are several things about this announcement which demand serious consideration, although at first glance one might almost think that it had been prepared by the humourous pen of Mr. W. S. Gilbert, or have emanated from the cheerful brain of the late Lewis Carroll. That a consulting engineer shall not receive surreptitious commissions or trade discounts in connection with his work is but common morality,

subject to laws which are not the exclusive property of any engineering society; and it is also freely admitted that an engineer should not be secretly connected with a contractor or manufacturer who may become a bidder for the work under his charge, but it really seems unnecessary for the Institution of Electrical Engineers to point out the necessity for the observance of the rules of common honesty to its members. The remainder of the circular, however, cannot be taken as other than a huge joke, not to be seriously considered.

Thus, members are forbidden individually to solicit employment, and yet the Institution itself makes an open bid to local authorities for the employment of its members as a whole, calling attention to the "high standing and great experience" of the electrical engineers composing the Institute, and to the sad fact that by advertising, the undertakers will deprive themselves of the services of this worthy body. Again, a consulting engineer may not place his card in the pages of a printed publication, yet he may hang his sign upon his office door, or even insert it in the directory of the office building in which his rooms are situated.

He may not solicit employment by letter, but if any one should, in consequence of this boldfaced advertising on the part of the Institute, write to him, he is actually permitted to answer such letter even though it may relate to his profession, and may lead to a professional engagement in spite of all precautions.

Really the document has not been drawn up with sufficient regard to the proprieties. It actually does leave loopholes, through which electrical engineers may obtain employment; there is a clause lacking, a clause forbidding any member to permit such a thing as professional work to be mentioned to him at all, but requiring him to accept commissions only under compulsion of bodily injury, making it necessary for him to be sought out by the keen scent of bloodhounds and dragged from his carefully hidden lair and haled to work by force.

There is but one consequence which can follow such an absurd piece of mediaevalism as this circular, the growth of an energetic, competent, efficient body of electrical engineers who will scorn to place themselves under such absurd regulations, and who will, by their activity and ability, place the members of the Institute in such a position that there will be no need for them to trouble themselves about the conduct of each other at all, since they will cease to be consulted professionally by any progressive clients. One cannot help recalling the fine scorn of the words addressed by the patriarch to his associates: "No doubt but ye are the people, and that wisdom will die with you!"

GOVERNMENT AND PRIVATE SHIPBUILDING.

WHY IT TAKES SO LONG A TIME TO BUILD AND EQUIP A NAVAL VESSEL FOR THE UNITED STATES.

American Society of Naval Architects and Marine Engineers.

IT is a well-known fact that the time required to build a naval vessel is much greater than that consumed in a private yard in the construction of a vessel of similar size and cost for the merchant service. The causes which produce the delays in government work are many and various, and it was to elicit discusion upon them that the paper presented before the American Society of Naval Architects by Mr. George W. Dickie, of the United Iron Works, of San Francisco, was prepared.

Mr. Dickie, who is undoubtedly extremely well qualified to speak upon the subject, believes that a great portion of the delay in government work is due to the practice of changing the designs in the course of construction. This he thinks might be largely remedied. It may not be possible so to design naval vessels that every detail plan is complete before the work is begun, but the design should be complete in every particular, and the specifications should state distinctly how the actual details are to be carried out. That this is not at present the case is shown by the fact that in a recent specification issued by the Navy Department more than two hundred of the most important items were indicated to be built "as directed," this meaning that detailed instruc-

tions would be given out from time to time during the course of the work.

"Before the contract is executed the design should be so complete that all structural materials required could be ordered at once, without having to submit new plans for approval. The latest plans from the Bureau of Construction come nearer meeting this requirement than any we have had hitherto. The location and dimensions of every compartment in the vessel should be determined, and should not be subject to change. The dimensions of every armor plate should be shown, and it should be ascertained beforehand that such dimensions are within the manufacturing capacity of the armor makers. The armament should be all finally settled as to amount and location, and the type of all gun ports not only indicated, but practically worked out. The magazines should be worked out in sufficient detail to demonstrate that they will properly stow the amount of amunition they are specified to carry. All means of handling ammunition should appear on the original design, and in capacity should correspond with the specifications. The arrangement of all machinery should be shown, with all piping and platforms, with a practical plan of getting into and out of machinery compartments. And in all such plans of machinery and boiler compartments the bulkheads should be shown their actual thickness of 12 inches, with deep beams and coamings that reduce the available space so much. This would save much time later on in rearranging machinery that must go into a space that has been reduced by the framing of its walls. Drainage and ventilation should also be fully worked out, as part of the original design. We understand that in future additions to the navy of the United States something of this kind will be attempted at the Navy Department. If this should be successfully carried out, and there is no reason why it should not be, these vessels will be several months further advanced at the date of the contract for their construction than has usually been the case, and many changes that have hitherto been necessary to meet the requirements of the design will be obviated."

Mr. Dickie refers to the common opinion that many of the changes are due to the wishes of the builder, and effectively controverts this view. The builder has nothing to gain and usually something to lose by the modifications which are made upon the work in progress, and he would greatly prefer to have complete plans from the start, as economical of both time and money.

The present system proceeds by the preparation of a specification, in conformity with which the various portions of the design must be made. Instead of following this plan, Mr. Dickie thinks that much time would be saved if the specifications were carefully prepared from a completed design. The present system is graphically described.

"In general this system involves the builder in the making of many working plans many times over before the superintending constructor is satisfied with them. Then they may go to the bureau for final approval; but it does not follow that because these plans have been made and remade over and over again, until the superintending constructor thinks they are right, the bureau will approve them and the work go on. For at the bureau they are subjected to another process of examinations and comparisons with work from other shipyards where similar ships are in course of construction, with a good chance of being sent back for revision, with perhaps copies of plans for similar work that had been approved for a sister ship building elsewhere, and this often sends the poor shipbuilder back to the first plan he submitted to the constructor.

"Where plans have to be submitted to the bureau for approval, and all plans involving any design have to be so submitted, we see no advantage in such plans being labored on sometimes for months by the superintending constructor and his staff of draftsmen, and by them returned over and over again to the builder for changes and corrections, then finally sent to the bureau for a similar process, there ending often in disapproval."

Undoubtedly a portion of the present delay arises from the division of responsibility. There should be only one naval architect responsible for the design of the vessel, outside of her propelling machinery. Now we have three parties trying to do the work: the Bureau of Construction and Repair, the superintending constructor, and the shipbuilder, and much time is lost in

trying to harmonize the ideas of these three parties. Since the final decision lies with the Bureau of Construction, the time expended by the other two parties is wasted and their efforts act to retard the completion of the work.

While there is much truth in all of Mr. Dickie's contentions, yet there is something to be said upon the other side. With all possible expedition in the work several years must be required to build a first class battle-ship or cruiser. During that time the progress of the art, both in shipbuilding and in warfare, make such material advances that much which might have been up to date at the commencement of the work is becoming obsolete at its conclusion. It is therefore the part of wisdom to leave details which are not absolutely essential in the early portion of the work to be settled at the time when they must be made.

Again, much of the delay in the construction of ships of war is due to features which are absent in vessels for the merchant marine.

Special materials, such as armor plate and special steels frequently cause delay, while strikes and labor troubles often play important parts in the retardation of the work. When to these is added the fact that the development of naval engineering in the work of other nations must be watched and met, so far as possible, we see that there are many unavoidable reasons for the preparation of details as the work is carried along.

Mr. Dickie is right in many of his points, but it can never be expected that work for the government can be conducted on the same methods as obtain in private contracts, and the best that can be done is to effect a compromise between necesarily conflicting conditions.

AERONAUTICAL ENGINEERING.

RECENT ACCIDENTS WITH DIRIGIBLE BALLOONS CONSIDERED AS STUDIES IN DEFECTIVE DESIGN.

Col. G. Espitallier, in Le Génie Civil.

AS a natural consequence of the success which attended to efforts of M. Santos-Dumont to win the Deutsch prize numerous attempts to navigate the air in dirigible balloons have followed, unfortunately with fatal results in several instances. In order to utilize the lessons which may be learned from these disasters Col. Espitallier has examined these conditions under which the failures ocurred, and from his paper in a recent issue of *Le Génie Civil* we make some abstracts, with comments.

It is not only in the category of dirigible balloons that the list of accidents is confined, since there have also been disasters in connection with ordinary balloons, but the former demand especial attention because of the effect of constructive details upon the results. Of these events Col. Espitallier examines especially those which befell M. Severo, and M. de Bradsky, showing conclusively the extent to which the violation of fundamental engineering principles could be held responsible for the results.

A so-called dirigible balloon differs from one of the common, or spherical, type in the form of the gas bag and in the provision of motive power operating some sort of a propeller. If, therefore, anything occurs to disable the motive power, a dirigible balloon becomes nothing more than one of the common type but of a different shape. It is therefore important that any one aspiring to experiment in aeronautical work should begin by obtaining experience in ordinary ascensions, in company with those already familiar with the subject, in order that he may not have to contend with the novelty of the situation at the same time with the performance of the novel machinery. In this respect M. Severo was undoubtedly deficient, since he had made but three ascensions in all prior to the one which resulted fatally, and in but one of these had he been in control of the balloon.

The Severo balloon contained several novelties in construction, the most marked of which was the shape of the gas bag. This was cut out underneath, much as if a lobe of an orange were taken out from the rest, except that the bag was spindle-shaped, instead of being spherical. The object of this construction was to permit the axis of the

propellers to be placed in the axis of the balloon, and thus avoid the transmission of the propelling force through the suspension members of the car. Two propellers were used, one at each end, the power being transmitted from petroleum motors in the car by means of shafts, provided with universal joints. Instead of a rudder, small propellers, with their axes at right angles to the main direction of motion were used for the purpose of turning the machine in any desired direction.

This machine was a bulky affair, being 30 metres in length, and 13 metres in diameter at the middle, there being two motors, one of 24 horse power, operating the rear propeller, and one of 16 horse power connected with the propeller in front, or a total of 40 horse power. Although the balloon of Santos Dumont carried but 16 horse power, the gas cylinder in that case was but 6 metres in diameter, giving 0.5 horse power per square metre of mid-section, while in the Severo balloon the power was but 0.3 horse power per metre of section.

Two great defects appeared in the Severo machine, one being the impossibility of providing a framework of sufficient rigidity to permit the smooth transmission of the power of the motors in the car to the propeller on the balloon; the other, still more serious, the close proximity of the car to the gas bag. As a consequence of the construction above described, the gas escaping from the relief valve, driven by the action of the propeller, mingled with the air in the space beneath the balloon, and igniting from the motors set fire to the whole machine.

The balloon of de Bradsky was in many respects similar to that of Santos-Dumont, the gas bag being 6.10 metres in diameter and 34 metres in length. In order to avoid the fate of Severo, de Bradsky took great precautions against fire, the car carrying the machinery being placed well below the balloon, and the motor so constructed that no ignition could be made from it. The propeller and the motor were carried upon a framework truss composed of steel tubing, so that all the impelling force of the motor had necessarily to be transmitted to the balloon through the medium of the suspension.

Here the defect in the design appeared, since this suspension consisted almost entirely of steel piano wire, without diagonal bracing, and consequently without lateral or longitudinal stiffness. The result of this imperfect connection between the two essential portions of the machine was the rupture of the wire connections during the violent pitching which occurred in the course of a sudden gust of wind, the car falling to the ground, and causing the death both of de Bradsky and his companion, M. Morin.

Both of these disastrous events bear witness to the necessity for the employment of competent engineering ability in the design of such difficult and delicate work as aeronautical machinery.

In such work, where lightness, strength, and stiffness must be united, and in which the maximum amount of motive power is carried and transmitted within the minimum limits of weight, the highest degree of ability in the disposition and use of materials of engineering is demanded. With these is involved a knowledge of the principles of equilibrium, since the question of balancing enters into the problem to a controlling extent. Under such circumstances it is almost criminal to permit ascensions to be made in machines in which such radical defects exist, and if experiments in aeronautics are to be continued, some sort of general inspection should be required to prevent the needless exposure of human life.

In this connection attention may be called to a plan which has been proposed to develope the possibilities of the aeroplane, which is generally admitted to possess greater scientific possibilities than any form of dirigible balloon. If an aeroplane, constructed upon such scientific lines as the machines of Langley or of Maxim were supported by a dirigible balloon it might be altogether possible to obtain such a degree of experience in its manipulation as to allow the degree of support to be gradually diminished and finally withdrawn altogether. The operation would resemble the use of the inflated belt in swimming instruction, the belt being gradually deflated as the pupil gains proficiency.

In some such experimental way as this the dirigible balloon may add to our stock of knowledge in aeronautical engineering, otherwise there seems to be little use in continuing experiments in which there is so much to lose and so little to gain.

CAVITATION IN SCREW PROPULSION.

A STUDY OF THE LAWS GOVERNING THE ACTION OF SCREW PROPELLERS AT HIGH ROTATIVE SPEEDS.

J. A. Normand—Comptes Rendus.

WITH the introduction of the steam turbine for marine propulsion, and the consequent increase in the rotative speed of screw propellers, certain phenomena have been observed, indicating a different action from that existing at ordinary speeds. This has been considered under various conditions, the latest contribution to the discussion being a paper presented by the well-known French marine engineer, M. J. A. Normand to the French Academy, and published in a recent issue of *Comptes Rendus.*

M. Normand calls attention to the fact that as long as nine years ago he drew attention to the phenomenon which he then termed the rupture of the cylinder of water acted upon by the propeller, but which has more recently been given the name of cavitation. This action may be described in the following manner:

When water is drawn through a pipe by the suction of any machine, such, for example, as a centrifugal pump, the velocity cannot exceed a certain limit, which depends upon the height of the lift. When the lift is zero the maximum theoretical velocity is that of water flowing into a vacuum under atmospheric pressure, being about 14 metres per second; but this velocity is never actually attained in practice, owing to certain operative losses. If the speed of the pump is increased beyond that necessary to produce this velocity the suction column is broken and the excess energy delivered to the pump is expended in the production of eddies and other forms of internal work.

In a similar manner the water is drawn toward the screw propeller of a ship with a velocity due to the atmospheric pressure augmented by the head of water corresponding to the submersion of the screw beneath the surface of the water. A cylinder of water, equal in diameter to that of the circle of the propeller, is drawn in by the action of the screw, and this cylinder remains continuous and unbroken until the velocity with which it approaches the screw exceeds a certain limit; beyond this speed cavities begin to form and the power is expended in the formation of eddies and whirlpools.

There are two points of difference between the column of water in the suction pipe of a pump and the cylinder drawn in by a screw propeller. In the latter case the water is not enclosed, and the velocity produced by the screw is not equal in all parts of the cylinder. Hence it follows that the velocity at which cavitation is produced in the case of the screw propeller, is much further from the theoretical value than in the case of the pump.

The extent of the movement produced by the action of the propeller upon the water is the measure of the resistance of the vessel. If, therefore, the velocity which forms one of the factors of the action of the screw is so high that cavitation is produced it becomes necessary to increase the other factor; namely, the mass of water under action, and this latter is proportional to the surface of the propeller.

Guided by the above considerations, M. Normand has formulated certain rules governing the relation of the surfaces of the circle of the propeller to the velocity, the principal of these relations being that the propelling surface should be proportional to the product of the resisting surface by the velocity, and he applies these rules to an analysis of existing examples of screw steamships.

The fact that the phenomena of cavitation have remained so long unobserved is doubtless due to the fact that the speeds formerly used were too low to produce noticeable effects of this nature.

Thus. in 1878, Froude stated that the propelling surface might be greatly reduced without producing a material diminution in the efficiency of the propeller. At that time the maximum speed of cruisers was about 18 knots, while to-day it exceeds 24 knots. It was about the same time that Froude made the above remark that testing tanks

began to be used, and in view of the information obtained by such experimental means, the effect of velocity upon the accepted laws of propulsion became necessarily modified, especially with respect to the question of similarity. The influence of the depth of submergence of the propeller is now understood to be of importance, as will be perceived when its action upon the head of the water delivered to the screw is considered. All these questions must become of increasing importance in view of the constant tendency toward higher speeds, both of propulsion and of propeller rotation.

The experience of Mr. Parsons, in connection with the application of the steam turbine to the direct operation of screw propellers will be remembered by all who have given attention to the subject of cavitation, and the manner in which he obtained satisfactory results by the deeper submergence of the propellers and the proper portion of surface to velocity, is quite in accordance with the theory advanced by M. Normand.

The comparison of the action of the suction of a screw propeller to that of a pump is interesting in that it may have a bearing upon the design of apparatus for jet propulsion. Although cavitation is commonly supposed to be a special property of high-speed screw propellers, it is evident that the suction entrance of a pump used for jet propulsion must be so proportioned that the flow of water may not be broken, otherwise an action altogether analagous to cavitation will occur, with corresponding loss in efficiency.

There is as yet no good reason to believe that any system of jet propulsion is as efficient as that produced by a properly proportioned screw propeller, and this opinion is confirmed by the researches of M. Normand.

OVERLAND SPACE TELEGRAPHY.

THE CRUISE OF THE CARLO ALBERTO TO CRONSTADT AND TO SPEZIA MAINTAINING COMMUNICATION WITH ENGLAND.

Report to the Italian Minister of Marine.

ALTHOUGH the greatest distance over which telegraphic communication by magnetic waves has been held has been over the Atlantic ocean, yet in some respects the record of the trials made during the recent cruises of the Italian war ship Carlo Alberto from England to Russia and to Italy is of greater importance. From the official report of Lieutenant Luigi Solari to Rear Admiral Mirabello and the Italian Minister of Marine, published as a supplement to the *Rivista Marittima*, some interesting information is available concerning this remarkable event.

The report, which is a very complete record of the cruises in the form of a log with comments, includes illustrations of the ship, showing the system of wiring, together with a chart of the routes, giving the location of the points from which communication was held, together with fac-simile records of the messages as received in Morse symbols on the tape of the recording instrument.

The cruises were made during the months of July, August, and September, 1902, starting from the Lizard, Cornwall, and proceeding by way of Denmark and the Baltic to the harbour of Cronstadt, where, in the presence of the Emperor of Russia and the King of Italy, Mr. Marconi exhibited the apparatus, and where messages were received from the station at Poldhu, a distance of 1,700 kilometres.

On the return cruise the Carlo Alberto made a stop at Kiel, where numerous messages were received and recorded, the distance being 1,300 kilometres from the transmit ting station in Cornwall, and communication was maintained continuously thereafter during the return to England. Many of these messages were of especial interest, notably one received by Mr. Marconi from Lord Kelvin when the Carlo Alberto was near the mouth of the Elbe, in the North Sea, about 1,100 kilometres from Poldhu.

The return voyages through the Mediterranean to Spezia repeated the success of the cruise in the Baltic, and the records show that satisfactory communications were had from Gibraltar, Cagliari in Sar-

dinia, and from Spezia, this latter communication being necessarily almost entirely overland, a distance of 1,200 kilometres from Poldhu, with the mass of the Alps between.

Apart from the interesting details of the voyage contained in the report, it is of importance to note that the best results were obtained by the use of Marconi's magnetic detector, instead of the coherer, although both were in use. This device, described in a paper presented before the Royal Society in June, 1902, does away with the necessity of tapping or decohering, and permits a telephone to be used as a receiver as well as the recording Morse instrument, and greatly increases the speed of reception.

The installation at the transmitting station of Poldhu was not materially changed for these experiments, there being four sets of wires supported on four towers of 70 metres in altitude, placed at a distance of 60 metres from each other. The wiring on the Carlo Alberto consisted of a horizontal cable stretched between the tops of the masts, from which a parallel set of seventy wires descended to the instrument room, in which were placed two receivers equipped with coherers and three magnetic detectors.

The experiences which were had in the case of the Atlantic transmissions to the steamship Philadelphia, concerning the greater facility in communication by night than by day, were again noted in these later experiments. Concerning this and other features of the trials the best information can be obtained from the summing up of Lieutenant Solari's report, as follows:

1. No limit has been observed as to the transmission of electric waves over the surface of the globe, provided the energy expended in the transmission is proportional to the distance to be covered.

2. Communication between transmitting and receiving radiotelegraphic stations is not prevented by the interposition of land.

3. The influence of the light of the sun is to diminish the range of radiation of electric waves, rendering it necessary to use a greater amount of energy in transmitting messages by day than by night.

4. The superior efficiency of the magnetic detector over the coherer as a receiving instrument is fully demonstrated, not only with respect to the freedom from tapping, but also because of its greater sensitiveness and convenience.

5. The experiments have demonstrated the entire practicability of the Marconi system, both for commerce and for warfare, without regard to distance.

MOULDING MACHINES AND FOUNDRY LABOR.

THE RELATION OF LABOR UNIONS TO RESTRICTION OF MACHINE OUTPUT IN THE FOUNDRY.

E. H. Mumford—New England Foundrymen's Association.

IN an address recently delivered in Boston before the New England Foundrymen's Association, Mr. E. H. Mumford made some very strong points, primarily with regard to the relation of the moulding machine to foundry labor, but applicable broadly to the use of labor saving machinery of all kinds.

In the first place Mr. Mumford showed that he has an abiding faith in the power of right, believing that : "no arbitrary, selfish action either of a corporation or a trades union can ever prevail against the mighty destiny of right—which alone is might."

The moulding machine resembles many other labor-saving devices in that it not only reduces the quantity of labor required to perform a given amount of work, but also enables it to be performed with labor of a lower grade and price. For this reason its use has met with more or less opposition from moulders, who naturally look askance at a device which enables satisfactory work to be done by laborers more rapidly than is possible by skilled men under the old methods.

As Mr. Mumford states, the moulding machine, at its first introduction, was hardly considered worthy of especial attention, but was operated by any one who chose to try it, the output being a variable quantity in the different shops. Now, however, the Iron Moulder's Union has decided to "lay hold of the machine" and to control

and regulate its use and output. Mr. Mumford does not in the least object to this, but desires to show that it is altogether possible to find a place for the moulding machine in the foundry which shall benefit and not injure the union moulder. Quoting the president of the union, Mr. Fox, he says that: "the union moulder will never be given the opportunity unless he is willing to do justice to the possibilities of the machine and shows a willingness conscientiously to assist in its development."

The force of this statement depends entirely upon the interpretation which is put upon the words "justice to the possibilities of the machine." In some shops doubtless it would be considered "justice" to the machine to let some heavy casting drop upon it and render it food for the cupola; in others it might be considered permissible to allow it to be operated by skilled moulders only, at a pace no greater than that set by hand moulding; while in other places the machine has been permitted to be operated to its full capacity by labour incapable of higher class work.

Mr. Mumford shows very clearly that there is plenty of work for the skilled moulder outside the scope of the machine, and that it is a wrong to the highly trained man to compel him to do work below his best capabilities. Even if the union is so disposed, it is impossible for it long to compel such a perversion of effort and ability.

"When a foundry owner purchases a machine, which he demonstrates in the shop by actual working is capable of saving labor or saving time and thus can cheapen cost, while dispensing with a kind of skill formerly necessary for the work it does rapidly and well, is there a man anywhere, without or within a trades union, who will pretend that there is any power on earth which can prevent the ultimate success of that machine? If the machine is capable of doing its work with unskilled labor, does any one suppose its operation by skilled men can be forced? Lastly, what arbitrary limitation of what Mr. Fox has called its "best possibilities," will be tolerated by the community at large, which has experienced the benefits of modern machinery, has doubled its lifespan by using the loom, the locomotive and the linotype?

"There are two methods by which local unions attempt and often temporarily succeed in limitation of machine economy. The first is by insisting that none but skilled molders should run the machines, with the usual and perfectly natural result that, as the man wants at least as much money for operating the machine as he had before, and doesn't want to work any harder than he did before, the saving effected by the machine is limited to what the molder is willing to concede the machine saves him in actual labor. Now, when a molder who has not been in the habit of using his muscles like an Italian digging a trench, but has for years been doing "first rate," as the foreman would say, putting up and pouring, say, 40 flasks of good work, patterns carefully rapped and drawn, weak corners faithfully swabbed and mended up, these last operations—probably one-half to three-fourths his time—requiring his skill and none of his strength—when this man, who is only half a laborer, is called upon to do what is entirely laborer's work, is it any wonder that he gets tired?

"The second method by which the molder is at the moment seeking to, perhaps only incidentally, limit machine output is by adopting into the union under a special classification the laborers already operating machines, with the result of bringing to bear that unfortunate influence incident to loyalty to a common body of men—a rivalry for popularity by keeping the unit of work as low as possible, while keeping the unit of pay as high as may be. This is a natural tendency of a man or of a body of men who have to sell the product of their hands or their heads for as good a price as they can get for it. In the individual, the effect of this disposition to do the best he can for self varies with the man's capacity for work. It is natural for some men to prefer activity to slowness. Then, too, some men are stronger than others and, in the long run, the active and exceptionally able man rises in output and income above the ranks of his mates.

"If it were possible to raise the standard of the weak by lowering that of the strong, there might be compensating benefits, but it is impossible; a weak man cannot exceed his strength, but it is lamentably easy for the strong man to do less than he is able."

The mistaken idea that the "lump of labor" is of limited size and that the use of machinery will serve only to exhaust it the sooner, is gradually being eliminated from the labor question among the more intelligent portion of the men. Levelling down for the purpose of nursing the job can never persist as an appeal to men whose intelligence is on the upward curve, and it is being more and more clearly perceived that a most important function of the labor-saving machine is to relieve mankind almost altogether from the more brutal and exhausting forms of labor, while at the same time creating more and greater opportunities for work of the higher and more profitable sort for a still greater number of men.

PROGRESS OF THE SIMPLON TUNNEL.

STATUS OF THE WORK OF THE SWISS AND ITALIAN SIDES OF THE LATEST GREAT ALPINE TUNNEL.

Sixteenth Quarterly Report.

WE have followed in these columns from time to time the reports made upon the progress of the great work of boring the Alps beneath the Simplon pass, many of the current features of such an undertaking furnishing most instructive information in engineering practice. In a recent issue of the *Schweizerische Bauzeitung* is given the substance of the sixteenth quarterly report, showing the progress which had been made up to October 24, 1902, with some interesting details upon the conduct of the work.

It will be remembered that the original project, upon which work was begun four years ago, involved the boring of a tunnel more than twelve miles (19,731 metres) long through the Alps, enabling the Jura-Simplon railway, running from Geneva up the Rhone valley, to connect with the Italian road from Milan at Iselle, and furnishing an all-rail route between Geneva and Milan, and connecting with the entire railway system of northern Italy; materially shortening the travelling distance between Milan and Calais, besides simplifying communication with western Switzerland. The plan includes a single-track main tunnel, with a smaller parallel tunnel, available from the first for drainage and ventilation, and capable of ultimate enlargement for a second track.

At the time of the completion of the sixteenth quarter, covered by the present report, the mountains had been penetrated to a distance of 7,888 metres on the Swiss side and 5,361 metres on the Italian side, or a total of 13,249 metres, or about 67 per cent. of the entire distance. This includes the extreme penetration, but of this more than 11,000 metres, or about 57 per cent. of the whole has been completed to the full section and lined with masonry.

The present report includes some interesting information concerning the geological constitution of the mountain, the borings continuing to be through gneiss on the Swiss side, the rock containing in most parts both white and black mica, although in some places it is entirely free from mica, being entirely white. In the headings on the Italian side the rock consists mainly of anhydrite, the borings passing through strata of dark limestone situated at angles varying from horizontal to 20 degrees to the southeast. At the extreme end of the borings on the Italian side the rock appears to be a similar gneiss to that met on the Swiss side, although not identical with the fundamental formation of which Monte Leone consists.

The rock temperatures continue to be unusually high on the Swiss side, reaching 44.4°C. (104°F.), while on the Italian side the maximum heat is given as 29°C. (84°F.) These are the actual temperatures of the rock, as determined by thermometers inserted into bore holes, the working temperature being kept within comfortable limits by ventilation and by the flow of water from the subterranean streams.

Still higher temperatures have been found in researches made for the purpose in bore holes of one metre in depth in selected positions free from external cooling influences. Under such conditions rock temperatures as high as 53°C. (127°F.) have been measured.

The flow of water has not materially

changed since the last report. The northern, or Swiss side, is almost absolutely dry, while on the southern side as many as seventeen streams have been tapped, these being of small size, the flow of all making but 18 litres per second (0.63 cubic feet per second). These streams are of minor importance, many of them gradually drying up and being replaced by others during the progress of the work. The great outburst of water, which caused serious trouble in the earlier portion of the work on this side continues to flow in undiminished volume, the discharge being 1118 litres per second, (about 40 cubic feet per second) according to careful measurements made in Auguset, The source of this flow is as yet unknown, no connection with any external supply having been discovered.

The number of men employed upon this great work continues at about three thousand, of which nearly nine hundred are engaged outside of the tunnel proper, being employed upon the power station, transportation work, etc. Only four to five hundred men are engaged in actual work in each end of the tunnel at any one time, the work being continued in successive shifts.

The plan of the work accompanying the report shows very clearly the manner in which the auxiliary tunnel permits the work to be carried on to advantage in the main bore. There are connecting passages giving communication between the two tunnels every 650 feet, and through these the tracks are laid enabling the material to be removed from the forward headings without having to pass the ones behind. In this manner it is possible to keep four gangs of men at work, enlarging and finishing the main tunnel, each gang being served by the auxiliary tunnel connection nearest to it.

The auxiliary tunnel, being driven ahead of the man bore, is always ready for the heavier work beside. The advantage of this mode of conducting the work is evident, since both tunnels, when completed to full size will represent a much smaller amount of excavation than would be required for a double track tunnel of full section.

During the sixteenth quarter there were 59 accidents to workmen on the Swiss side, of which two were serious, and on the Italian side there were 89 slight accidents, and no serious ones.

REINFORCED CONCRETE MASONRY.

THE REMARKABLE INCREASE IN RESISTANCE TO COMPRESSION OF CONCRETE PIERS AND COLUMNS.

M. Considère, in Le Génie Civil.

BY far the greater portion of the research and experiment which has been given to reinforced-concrete construction has been directed to the investigation of beams and floors, or similar details in which the combination is subjected to flexure and partial tension. While these undoubtedly form most useful applications, of wide value, they by no means indicate the limitations of the principle.

The question of the resistance of reinforced concrete to crushing stresses forms the subject of a series of important papers by the well-known French engineer, M. Considère, published in recent issues of *Le Génie Civil,* and although various phases of the matter are dealt with, we may extract but a few of his conclusions.

Concrete is generally supposed to possess a high degree of resistance to crushing in itself, and nearly all the attempts which have been made to supply it with a metallic reinforcement have had in view the provision of resistance in that portion of the structure subjected to tensile stresses. Thus, in the case of arches, the wire, rods, or other metallic reinforcements are so placed as to resist the tendency to open at the points of usual rupture, the compressive strength of the concrete being left to meet the crushing forces. Again, in floors and beams, the reinforcement of metal is placed below the neutral axis as far as practicable, in order to meet the tension there caused by the deflection under loading.

The usual method of constructing compression members in reinforced concrete has been to insert metal rods parallel to the axis, so that in the case of piers of columns there have been used vertical bars or rods,

in some instances old rails having been employed, although it must have been evident that the resistance of the two materials could not in any way be equalised to the compressive stresses under such conditions. The real idea in such structures seemed to have been the provision of some method of tying in the reinforcement of the beams and floors to the metal in the pillars or piers by which they were supported.

M. Considère, however, proceeds differently. Observations of the manner in which piers of simple concrete yield to crushing serve to show the manner in which they can best be reinforced. When such tests are made, it is seen at once that the first evidence of yield appears in a swelling in diameter about the middle of the pillar. When the load is increased this swelling becomes greater and greater until the mass bursts, so to speak, and the upper portion descends upon the lower, crushing the whole into one heap. This action reveals the fact that the weak element in the pillar is its resistance to bursting, showing that the true plact to apply reinforcement is about the circumference. As a consequence pillars have been made with metallic hoops about them, or more simply, a winding of wire has been used, this reinforcement being slightly buried beneath the surface in order to permit the appearance to be unaffected. The result of such reinforcement under test is truly remarkable, and there is little doubt that such a construction will be found of the utmost value both in engineering and architectural work.

Thus it was found that a pillar of simple concrete, after a period of 14 days was capable of resisting a load of but 50 kilogrammes per square centimetre, while a similar pillar reinforced by a winding of wire amounting to 0.035 per cent. of its volume, carried a load of 460 kilogrammes per square centimetre. A pillar of simple concrete, after a period of 100 days, sustained a load of only 170 kilogrammes per square centimetre, while a reinforced pillar carried 740 kilogrammes.

While these results appear remarkable, there is every reason to see why such should be the case. Strictly speaking the pillar does not yield to compression at all, but to the radial tension shown in the tendency to burst under load. This tendency being resisted by the wire wrapping the mass becomes as resistent as solid rock, exactly as is shown by the results of the tests. The case is analogous to the behaviour of rubber under compression. The material is practically incompressible, and when subject to pressure in one direction it increases in the free dimension; a rubber car spring, for instance, swelling in diameter as it is compressed by the weight placed upon it. If such a spring were wound with wire it would become practically solid, and the measure of its resistance would be the tensile strength of the wire with which it was reinforced. The same state of affairs exists with the concrete column, and the action of the reinforcement is altogether similar.

The ease with which this application of reinforced concrete can be made in building and engineering work should cause it to be extensively employed, the economy and excellence of the method being apparent.

THE DETERMINATION OF WAGES.

PREMIUM AND BONUS SYSTEMS AND THEIR RELATION TO THE SOLUTION OF THE LABOR PROBLEM.

American Society of Mechanical Engineers.

AMONG the papers presented at the recent convention of the American Society of Mechanical Engineers was one by Mr. Frank Richards, entitled "Gift Propositions for Paying Workmen," which is of consequence mainly for the discussion which it elicited.

Mr. Richards, evidently speaking with all the experience of the workman in the shop behind him, objects to any system which has for its object the increase of the workman's output by offering him a portion only of the increased value thus obtained. He calls all such "gift" propositions, and stigmatizes them as such plans as a "sharper would propose to a simpleton." This position assumes that there is some inherently correct day's work which the employer is bound to

get and the employe obliged to give, and that if more work is done the man should be fully paid on such a basis. This is really begging the whole question. The truth is that there is no known fair day's work, and no known fair day's wages; if these things were known there would be no trouble whatever, and everything would be lovely. No two workmen can do the same value of work in a given time, and the cost of running a shop for a given time is different in every shop. It is the object of such systems as the premium and bonus plans to discover what a fair day's output for each individual man really is, and to adjust his wages on that basis.

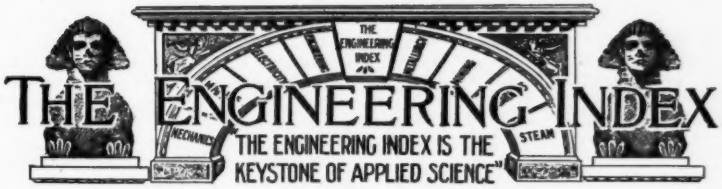
To the mere layman, who does not work in a shop and does not employ workmen the idea occurs: if there is so much difficulty in finding out how much a given amount of time is worth to both parties, why drag in the time question at all? The answer will come at once from both parties to the controversy. Says the workman: "I have to pay my rent by time, I have to feed myself and my family by the day, in short, all my expenses are measured by time!" Says the manufacturer: "All my establishment charges are measured on a time basis; the interest on my capital is measured by time, depreciation, office expenses, motive power, insurance, and everything else is based on time." In short, both parties put up the unanswerable plea: "I need the money."

Leaving aside such special pleadings as based on about as unbusinesslike a foundation as that of the highwayman who holds up the helpless traveller upon a dark night, let us look at the subject for a moment upon a different basis. There is apparently an insuperable difficulty in finding out the payment value of any man's time. A value which suits the payer does not suit the payee, and there is no immediate prospect that this problem will be solved to the satisfaction of both parties. Under these circumstances the best thing to do with the time basis is to drop it altogether. The workman makes something which the employer wants, not for himself, but to pass on to somebody else who wants it still more, and who is willing to pay a piece price for it. In earlier times, when each workman ran his own little place and sold his products direct to the customer, there was no question about day's wages, or premium plans, or any such contrivances; the customer asked how much the thing cost, and the workman charged him all he thought he could get, and the transaction was closed. Why this direct method should not be continued when a third party has injected himself into the business remains to be shown. As a matter of fact, this third party, commonly known as the employer, belongs partly to the side of the workman and partly to that of the customer. He provides the shop, the tools, the capital, and other of the facilities which aid in the production of the work, and he is thus like the workman, interested in getting this expense plus a certain profit back out of the customer. At the same time he acts as the collecting agent, who gathers in the money from the customer, and passes a limited portion of it on to the workman who with himself, makes the article. Each of the two is therefore entitled to a portion of the piece price which the customer pays, and it is over the division of the amount that all the differences arise; the customer usually being altogether helpless.

Apparently the true basis is for each of the parties to act on his own account. The workman might equally well continue to sell his product to the manufacturer, who, while bearing the new name of employer, would then take the identical place of the old time customer, while the employer, adding sufficient to the price to repay him for his outlay plus a profit, again sells to his customer.

Since the facilities furnished by the manufacturer enable the workman to produce things to a better advantage than formerly, he is in a position to charge a lower price than if he had to do the work with his own limited means, and thus a piece price can be determined, just as in the earlier times, being all the workman can possibly get.

The whole obstacle in the way of the adoption of piece work is the apparently insuperable requirement of the employer that the wages of the man, measured by time, should not exceed a certain limited advance on the old day's wages. This he should forget altogether. Let the workman make whatever he can; do not attempt to limit his gains; the thing to be reduced is the piece cost of the article, for it is upon that, and not upon the amount the workman receives that the profits depend.



The following pages form a DESCRIPTIVE index to the important articles of permanent value published currently in about two hundred of the leading engineering journals of the world,—in English, French, German, Dutch, Italian, and Spanish, together with the published transactions of important engineering societies in the principal countries. It will be observed that each index note gives the following essential information about every article.

(1) The full title,
(2) The name of its author,
(3) A descriptive abstract,
(4) Its length in words,
(5) Where published,
(6) When published.

We supply the articles themselves, if desired.

The Index is conveniently classified into the larger divisions of engineering science, to the end that the busy engineer and works manager may quickly turn to what concerns himself and his special branches of work. By this means it is possible within a few minutes' time each month to learn promptly of every important article, published anywhere in the world, upon the subjects claiming one's special interest.

The full text of any article referred to in the Index, together with all illustrations, can be supplied by us. See the "Explanatory Note" at the end, where also the full titles of the journals indexed are given.

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CIVIL ENGINEERING

BRIDGES.

Design.

Bridges. Review of a book by T. Claxton Fidler, entitled "A Practical Treatise on Bridge Construction: A Text-book on the Design and Construction of Bridges in Iron and Steel. 5200 w. Builder—Nov. 1, 1902. No. 51611 A.

Double Deck.

Double Deck Bridge for P. Ft. W. & C. Ry. Crossing the Allegheny River at Pittsburg, Pa. E. A. Amaden. Brief illustrated description with an account of the removal of the old bridge. 1100 w. Pro Engrs' Soc of W Penn—Oct., 1902. No. 51779 D.

Fire Damage.

The Fire on the New East River Bridge. An illustrated account of the fire which consumed the temporary framework on the New York tower and also the foot-walks, though the main cables are believed to be only slightly injured. Also brief editorial. 2200 w. Ir Age—Nov. 13, 1902. No. 51673.

The Fire on the New East River Bridge. An illustrated account of the fire, the damage, loss, etc. 2800 w. Eng Rec—Nov. 15, 1902. No. 51719.

We supply copies of these articles. See page 653.

The Fire on the New York Tower of the New East River Bridge. An account of this fire with report of damage by Mr. Gus. C. Henning, who personally examined the scene of the fire. Also report of by Mr. Gustav Lindenthal. 2400 w. Eng News—Nov. 13, 1902. No. 51690.

The New East River Bridge Fire. An illustrated account of this disaster, the damage, and the lessons to be learned. 1200 w. Sci Am—Nov. 22, 1902. No. 51775.

Waterproof Wrapping for the Cables of the New East River Bridge, New York. Wilhelm Hildenbrand. Describes methods that have been in use for preserving cables, and have proved successful, and especially the new method adopted for the protection of the cables of the New East River Bridge and the manner of enclosing them in a waterproof covering. 3000 w. Eng News—Nov. 13, 1902. No. 51685.

Foundations.

Cooper's Bridge Foundation Specifications. Selected illustrations and abstracts indicating the character of general specifications, prepared by Mr. Theodore Cooper, soon to be published. 3800 w. Eng Rec—Nov. 1, 1902. No. 51583.

Long Spans.

Some Interesting Long Span Bridges Now Under Construction. Illustrates and describes the general design and special features of interesting bridges now under construction. 5000 w. Eng News—Nov. 20, 1902. No. 51820.

Moving Loads.

Impact and Fatigue in Railway Bridges. J. Graham. Discusses the calculation of the moving load stresses. 1500 w. Engr, Lond—Nov. 14. 1902. No. 51862 A.

Rhone.

The New Bridge over the Rhone at Valence (Le Nouveau Pont sur le Rhone à Valence). A description of the new masonry arch bridge, now under construction. There are four segmental arches of 30 metres span. 2000 w. Génie Civil—Oct. 25, 1902. No. 51902 D.

Steel Arch.

Steel Arch Electric Railway Bridge Over the Vermillion River at Birmingham, O. Illustrates a high-class construction for interurban electric railway service. 700 w. Eng News—Oct. 30, 1902. No. 51458.

Viaduct.

The Des Moines Steel Viaduct. An illustrated description of an important structure on what is known as the Boone cut-off. 2000 w. Engr, Lond—Oct. 24, 1902. No. 51492 A.

Wreck.

Fall of a Railway Bridge Near Meadville, Pa. Illustrations and particulars of the accident. 1200 w. Eng News—Oct. 30, 1902. No. 51457.

CANALS, RIVERS AND HARBORS.

Breakwater.

The Break in the Genoa Breakwater (Der Durchbruch des Hafendammes von Genua). E. Bavier. An illustrated account of the injury done to the Genoa breakwater in Nov., 1898, and the manner in which it was repaired. Two articles. 3500 w. Schweiz Bauzeitung—Oct. 25, Nov. 1, 1902. No. 51950 each B.

Canal Traction.

Electric Canal Traction in Germany (La Traction Electrique sur Canaux en Allemagne). Marcel Fabre. With especial reference to the installation of trolley tractors on the Teltow Canal between the Spree and the Havel. 2000 w. 1 plate. Génie Civil—Oct. 25, 1902. No. 51903 D.

Coast Protection.

The Protection and Improvement of Foreshores by the Utilization of Tidal and Wave Action. Discussion of paper by R. G. Allanson-Winn. Ill. 3500 w. Pro Am Soc of Civil Engrs—Nov., 1902. No. 52014 E.

Dredging.

The Cost of Dredging on the Massena Canal. Abstract from a recent paper by John Bogart before the International Nav. Cong. Gives data of cost of dredging in this canal. 1100 w. Eng News—Oct. 30, 1902. No. 51454.

Erie Canal.

History of the Erie Canal. Briefly reviews the first construction and improvements made at different times, discussing the proposed enlargement to a 1,000-ton barge capacity, and the cost. 1500 w. Marine Review—Oct. 30, 1902. No. 51469.

Heysham.

Progress of Heysham Harbor Works. An illustrated description of the harbor works being constructed for the Midland Railway. 3000 w. Transport—Nov. 14, 1902. No. 51847 A.

Morris Canal.

The Inclined Plane of the Morris Canal. Brief illustrated description of the curious inclined plane for raising canal boats over elevations on this canal in New Jersey. 800 w. Sci Am—Nov. 15, 1902. No. 51691.

Panama.

The Panama Canal and the Regulation of the Chagres River. Gen. H. L. Abbot. An exhaustive review of the relation of the Chagres river to the Panama canal,

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giving a complete project for flood control and water supply. 15000 w. Engineering Magazine—Dec., 1902. No. 51991 B.

Rio Negro.

The Regulation of a River of Semi-Constant Regime (E Regolarizzazione del Fiume a Regime Semicostante). C. Cipolletti. A hydrographical study of the Rio Negro, Argentina, with map of the river and its drainage basin. 7500 w. Ann d Soc Ing e Arch Ital—No. III, 1902. No. 51971 H.

River Improvement.

Full Use of the Rivers at Pittsburg and the Removal of the Obstructions to Such Use. Capt. William L. Sibert. Reviews the present situation at Pittsburg, showing the possibilities of water transportation, and gives a preliminary study with sketches showing a plan for raising bridges in the Allegheny River. 3000 w. Pro Engrs' Soc of W Penn—Oct., 1902. No. 51778 D.

Improvement of the Black Warrior, Warrior and Tombigee Rivers, in Alabama. Continued discussion of R. C. McCalla's paper. 8700 w. Pro Am Soc of Civ Engrs—Nov., 1902. No. 52012 E.

River Transportation.

Artificial Limitations of Commerce on Our Rivers. John F. Dravo. Considers the best conditions demanded by river commerce as it now exists, especially the towing system, and bridge construction. 2300 w. Pro Engrs' Soc of W Penn—Oct., 1902. No. 51780 D.

Tiber.

The Completion of the Regulation of the Tiber (Sal Compimento della Sistemazione del Tevere). Giovanni Cadolini. An account of the regulation works establishing a navigable channel from Rome to the sea. 6000 w. 1 plate. Ann d Soc Ing e Arch Ital—No. III. 1902. No. 51972 H.

CONSTRUCTION.

Building Construction.

The Hibernia Building, New Orleans. I. Foundations. An illustrated detailed description of special features in a 12-story steel cage building. The present article considers the foundations which are built on very wet soft ground. 2500 w. Eng Rec—Nov. 22, 1902. No. 51844.

Dams.

A Plan for Constructing Dams at Great Depth in Water-Bearing Material, with Especial Reference to the Bohio Dam. J. T. Ford. An illustrated description of the method of construction proposed by the writer, with reasons why other proposed plans are not approved. 2000 w. Eng News—Nov. 6, 1902. No. 51593.

Floors.

Fire and Load Tests of Concrete Steel Floors. Illustrated descriptions of tests of the White floor system and the American floor system. 1200 w. Eng Rec—Nov. 1, 1902. No. 51587.

The Failure of a Warehouse Floor in Minneapolis, Minn. Sketches of the construction and particulars of the accident which occurred Nov. 7. 2000 w. Eng News—Nov. 20, 1902. No. 51821.

The Johnson System of Floor Construction. Peter B. Wight. An illustrated description of a system which does away with the I beams, only retaining small I beam struts between the columns in opposite directions to the girders. Reports of tests made. 2500 w. Br. Build—Oct., 1902. No. 51428 D.

Grain Elevators.

The New Grain Elevators at Genoa (I Nuovi Silos per il Grano a Genova). A general description, with illustrations, of the important new warehouses and elevators at the port of Genoa, Italy. Serial, part I. 2000 w. 1 plate. L'Industria—Nov. 16, 1902. No. 51976 D.

Pile Drivers.

Railway Pile Drivers. Abstract of a committee report presented at the Minneapolis meeting of the Assn. of Ry. Supts of Bridges and Buildings. 4400 w. Eng News—Oct. 30,1902. No. 51453.

Roads.

Cost of Road Maintenance and Road Maintenance Efficiency. W. Worby Beaumont. Suggests methods of finding values of cost and efficiency for comparison. 1500 w. Engr, Lond—Oct. 24, 1902. No. 51490 A.

Road Building with Convict Labor in the Southern States. J. A. Holmes. From the "Year Book" of the U. S. Dept. of Agriculture. Information concerning the classes of convicts employed, their management, the kinds of roads built, etc. 5000 w. Eng News—Nov. 20, 1902. No. 51824.

The Work of the Massachusetts Highway Commission. W. E. McClintock. Read before the Am. Soc. of Munic. Imp. Reports the work accomplished and the methods of execution. 1500 w. Munic Engng—Nov., 1902. No. 51546 C.

The Work of the New York State Highway Commission. Edward A. Bond. Read before the Am. Soc. of Munic. Imp. Information concerning the work accomplished and work remaining to be done, with remarks on its importance. 1200 w. Munic Engng—Nov., 1902 No. 51545 C.

Tunnels.

The North River Tunnels by the Sooy-

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smith Freezing Process. An illustrated outline description of the method proposed. 2800 w. R. R. Gaz—Nov. 21, 1902. No. 51826.

The Simplon Tunnel (Simplon Tumrel).. Abstract of the quarterly report showing the progress of the work between June and September, 1902. 1800 w. Schweiz Bauzeitung—Nov. 15, 1902. No. 51953 B.

Underpinning.

A Protracted Job of Underpinning. Illustrated description of very difficult work at Exchange Place, New York, where the soil is very fine sand and the building of a steel-cage structure endangered old buildings. 3500 w. Eng Rec—Nov. 1, 1902. No. 51585.

Vaults.

The Determination of the Line of Thrust of Barrel Vaults by the Law of Lease Work (Bestimmung der Stützline von Tonnengewölben auf Grundlage des Satzes von de Kleinsten Formänderungsarbeit). J. V. Gerstenbrandt. An exhaustive analytical and graphical analysis acording to the method of Müller-Breslau. 5000 w. 2 plates. Oesterr Wochenschr f d Oeffent Baudienst—Nov. 8, 1902. No. 51978 D.

MATERIALS.

Cement.

Some Notes on Cement Masonry. I. N. Knapp. Read before the Am. Gas Lgt. Assn. Concerning the composition, testing, setting, strength, etc., of hydraulic cement. Also discusses the construction work, the proper way to lay brick in cement mortar, etc. Also discussion. 9500 w. Am Gas Lgt Jour—Nov. 10, 1902. No. 51639.

The Use of Slag in Cement Making. Extracts from advance sheets of a report by Edwin C. Eckel on the Utilization of Iron and Steel Slags, in "Mineral Resources, 1901." 1200 w. Eng Rec—Nov. 1, 1902. No. 51584.

Cement Works.

The Portland Cement Works at Djatkowo (Die Portland zement fabrik Djatkowo). Carl Naske. An illustrated description of a works having an output of 500,000 barrels of 170 kilograms per year; situated at Djatkowo, near Briansk, Russia. 1800 w. 1 plate. Zeitschr d Ver Deutscher Ing—Nov. 1, 1902. No. 51915 D.

Concrete.

Relative Compressive Strength of Gravel and Broken-Stone Concretes. Sanford E. Thompson. Outlines tests, made in Boston, in 1896, giving interesting comparison between the compressive strength of concrete made with gravel and the strength of similarly proportioned concrete made with broken stone. 2000 w. Am Archt—Nov. 1, 1902. No. 51464.

Corrosion.

Corrosion of Steel. A report of experiments made at the Insurance Engineering experiment station, Boston, with comments on the lasting qualities of modern methods of construction. Ill. 5500 w. Ins Engng—Oct., 1902. No. 51537 C.

Fireproof Material.

To Render Buildings Fireproof. An illustrated description of how the New York Building Department tests all fire-resisting material. Also editorial. 2800 w. Fire & Water—Nov. 8, 1902. No. 51633.

Reinforced Concrete.

Iron Concrete Piers (Ueber Betoneisen Piloten). F. v. Emperger. A description of the reinforced concrete construction of the piers of the new bridge at Brumath, Alsace. 1800 w. Zeitschr d Oesterr Ing u Arch Ver—Nov. 7, 1902. No. 51923 B.

Recent Experiments with Concrete-Iron Beams (Neue Versuche mit Betoneisen Valken). Dr. Max V. Thullie. An examination of tests recently made in Holland showing the distribution of the stresses in the concrete and in the metal. 1800 w. Zeitschr d Oesterr Ing u Arch Ver—Oct. 17, 1902. No. 51919 B.

The Hennebique System of Armored Concrete Construction. Leopold Mensch. Reviews early uses of concrete showing its durability, and discusses the value of combinations of concrete and steel, and the things to be guarded against in their use, its applications and value as a building material. Ill. 4800 w. Jour Assn of Engng Socs—Sept., 1902. No. 51534 C.

The Resistance of Reinforced Concrete to Compression (Résistance à la compression du Béton Armé). M. Considère. Discussing recent experiments, showing the extent to which pillars of concrete are strengthened by metallic hoops. Serial. Part I. 2500 w. Génie Civil—Nov. 1, 1902. No. 51905 D.

The Theory of Iron Concrete Construction (Theorie van Cement IJzerconstruction). L. A. Sanders. A review of the theory of Rabut, with data and results of experiments upon reinforced concrete beams. Three articles. 9000 w. De Ingenieur—Oct. 25, Nov. 1, 8, 1902. No. 51960 each D.

Timber Preserving.

Timber Preserving Plant of the Alamogordo Lumber Co. Illustrated description of a plant intended particularly for treating ties and bridge timbers by the Wellhouse (zinc-tannin) process. 2500 w. Eng News—Oct. 30, 1902. No. 51255.

We supply copies of these articles. See page 653.

MUNICIPAL.

Destructors.

Electricity from Refuse—the Case for the Modern Destructor. W. Francis Goodrich. Abstract of a paper read before the Manchester Soc. of the Inst. of Elec. Engrs. Discusses how far a destructor may be relied upon as a power producer, the conditions needed for success, reporting tests, etc. 3800 w. Elec Engr, Lond —Nov. 14, 1902. No. 51852 A.

Dust.

The Dust Problem. Sir James Crichton-Browne. Atmospheric dust, its sources, the injurious effects, and remedies. 13300 w. Jour San Inst—Oct., 1902. No. 51680 E.

Electric Plants.

See Electrical Engineering, Generating Stations.

Pavements.

The Maintenance of Asphalt Streets. Continued discussion of paper by James N. Hazlehurst. 2000 w. Pro Am Soc of Civ Engrs—Nov., 1902. No. 52015 E.

Paving Brick.

The Equipment of a Modern Paving Brick Plant. Willard D. Richardson. A paper given in the *Transactions* of the American Ceramic Society. Plans and description of a plant near Cleveland, Ohio. 2000 w. Eng Rec—Nov. 15, 1902. No. 51721.

Septic Tanks.

A Septic Tank at Bedford, Ind. Plan and description of the plant. 1300 w. Eng Rec—Nov. 15, 1902. No. 51722.

New Automatic Regulators for Septic Tanks and Contact Beds. Illustrates and describes two recently patented devices, explaining their operation. 2300 w. Eng Rec—Nov. 8, 1902. No. 51660.

Sewage.

Sewage Disposal at Shelby, Ohio. Benjamin H. Flynn. Illustrated description of the purification works which consists of two sludge pits, a settling basin and two intermittent filters of cinder and gravel. 1600 w. Eng News—Nov. 20, 1902. No. 51825.

The Sewerage of Rochester, N. Y. W. J. Stewart. Read before the Am. Soc. of Munic. Imp. Brief illustrated description of the sewers, and their construction, the materials used, etc. 700 w. Munic Engng—Nov., 1902. No. 51542 C.

The Vitality of Sewage Bacteria in Soil and the Antagonism of Soil Bacteria to the Typhoid Bacillus. A review by G. C. Whipple of investigations during the last few years carried on for the Local Government Board of England, as given in a paper by Dr. Sidney Martin. 1600 w. Eng Rec—Nov. 8, 1902. No. 51661.

Sewers.

Notes on Designing Chicago Sewers. C. D. Hill. Gives a table and diagram, compiled from the experience of the writer, giving much information of value; reviews the history of the development of Chicago sewers; considers the influence of slope, and presenting conclusions. General discussion follows. 10600 w. Jour W Soc of Engrs—Oct., 1902. No. 51431 D.

Smoke.

The Treatment of Smoke. A Sanitary Parallel. W. N. Shaw. Discusses the problem of smoke abatement. 7300 w. Jour San Inst—Oct., 1902. No. 51679 E.

Storm Flows.

Storm Flows from City Areas and their Calculation. Ernest Wilder Clarke. Discusses methods of calculating the size of sewer needed to carry off surface water. 4200 w. Eng News—Nov. 6, 1902. No. 51594.

Street Cleaning.

Street Cleaning Statistics for Cities Above 3,000 Population in the United States. A. Prescott Folwell. A summary from detailed reports in the Municipal Year Book, with explanatory notes. 1400 w. Eng News—Nov. 20, 1902. No. 51822.

See Mechanical Engineering, Automobiles.

WATER SUPPLY.

Artesian Supply.

The Artesian Water Supply of Long Eaton, England. Notes from a paper by George Hodson, giving a description of the works. 2200 w. Eng Rec—Nov. 8, 1902. No. 51663.

Consumption.

The Consumption of Water in Cities and Towns of Massachusetts. Information from the report of the Massachusetts State Board of Health for 1900, designed to cover all available reliable records since the various water-works were installed. 1500 w. Eng News— Nov. 20, 1902. No. 51819.

Electrical Corrosion.

See Street and Electric Railways, Stray Currents.

Filtration.

The Maignen Preliminary Filters for the Preparation of Water for Sand Filtration. A description of these scrubbers and a discussion of their efficiency and economy condensed from a report made by Messrs. Rudolph Hering and George W. Fuller to the Maignen Filtration Co., based on experiments at Philadelphia.

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3300 w. Eng Rec—Nov. 22, 1902. No. 51843.

Fire Protection.

An Ideal Water Supply. George F. Chase. Discusses the proper distribution of water, hydrants, pipe, etc. 2500 w. Fire & Water—Nov. 1, 1902. No. 51496.

Irrigation.

Irrigation System of the Arkansas Valley Sugar Beet and Irrigation Land Co., Colorado. W. P. Hardesty. An illustrated description of this extensive system, with its history. 6300 w. Eng News—Nov. 13, 1902. No. 51688.

Meter System.

Meter System of the Water Department of Baltimore, Md. Robert L. Clemmitt. A description of the testing, inspection, quarterly reading and general management. Ill. 2000 w. Eng News—Oct. 30, 1902. No. 51448.

New York.

State Water Supply in New York. George W. Rafter. Read before the Am. Soc. of Munic. Imp. Considers the advisability of reserving a supply for the exclusive use of cities and towns, showing that water could be delivered by gravity, without excessively long conduits, to practically all the cities and towns in the state. 1000 w. Munic Engng—Nov., 1902. No. 51544 C.

Pollution.

Inorganic and Organic Sources of Contamination of Water Supplies. E. Starz. An illustrated study of the sources of contamination, their danger, etc., showing the value of a technical, chemical and biological examination of a public water supply. 5000 w. Jour Assn of Engng Socs—Sept., 1902. No. 51535 C.

Pumping Engines.

Large Waterworks Pumping Engines in Holland (Groote Pompwerkturgen voor Waterleidingen in Nederland). J. C. Dijxhoorn. Describing the water works pumps at The Hague, Utrecht, Rotterdam, and Amsterdam. 6000 w. 5 plates. De Ingenieur—Nov. 15, 1902. No. 51962 D.

Reservoirs.

A New Reservoir at New London, Conn. An illustrated description of a new reservoir nearly completed, which will almost double the water supply. 2300 w. Eng Rec—Nov. 22, 1902. No. 51842.

Report of Aqueduct Commission. The report of the Croton aqueduct commissioners on the subject of the changes in the construction of the new Croton dam and Jerome Park reservoir which had been pronounced defective. Ill. 1200 w. Fire & Water—Nov. 15, 1902. No. 51762.

Rochester, N. Y.

Distributing System of the Rochester Water Works. W. N. Radenhurst. Read before the Am. Soc. of Munic. Imp. Describes a double system of supply; from the Genesee River by direct pumpage, and a gravity system from Hemlock Lake. 1000 w. Munic. Engng—Nov., 1902. No. 51541 C.

The Water Supply of Rochester, N. Y. John F. Skinner. Read before the Am. Soc. of Munic. Imp. Brief review of these works which take their supply from Hemlock Lake. 1200 w. Munic Engng—Nov. 1902. No. 51540 C.

St. Louis Works.

Improvements of St. Louis Works. Describes a new hydraulic dredge which enables the basins to be cleaned while in regular service, and the plan for filtration. Ill. 1600 w. Fire & Water—Nov. 22, 1902. No. 51832.

South Wales.

The Rhondda Water Supply. W. D. Wight. Abstract of a paper read before the S. Wales Inst. of Engrs. Suggests methods of obtaining water for this landlocked valley where an increased supply is greatly needed. 2200 w. Ir & Coal Trds Rev—Sept. 26, 1902. No. 50974 A.

Water Tower.

The Water Tower at Grand Rapids, Wis. Illustrated description of a covered steel tank, 154 feet above the ground, supported on 4 columns resting on concrete foundation piers. 1000 w. Eng Rec—Nov. 8, 1902. No. 51662.

MISCELLANY.

Address.

Presidential Address before the Institution of Civil Engineers. John Clarke Hawkshaw. Also editorial. Considers docks, timber, coal, water power, etc. 6000 w. Engng—Nov. 7, 1902. Serial. 1st part. No. 51744 A.

Argentina.

Engineering in Argentina. E. L. Corthell. An outline of the physical conditions, the climate, geology, etc., of this country, with an account of important engineering works, and brief review of the history. Ill. 5300 w. Jour W Soc of Engrs—Oct., 1902. No. 51433 D.

Depreciation.

Depreciation as Affecting Engineered Structures. Horatio A. Foster. The object of the paper is to set forth some of the usual methods of treating depreciation, and some that are less commonly considered. Also discussion. 8000 w. Pro Engrs Club of Phila—Oct., 1902. No. 51430 D.

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ELECTRICAL ENGINEERING

COMMUNICATION.

Cables.

The Completion of the Pacific Cable, and Its Lessons. Calls attention to lessons from the history of this undertaking, and the prospects of improved communication. 2400 w. Elec Rev, Lond—Nov. 7, 1902. No. 51738 A.

The Manufacture of Cables (Ueber Kabel fabrication). Gustav Bergholtz. A review of the development of the manufacture of submarine telegraph cables, with illustrations of modern machinery and methods. 8000 w. Zeitschr d Oesterr Ing u Arch Ver—Oct. 31, 1902. No. 51921 B.

The Pacific Cable. Illustrates and describes some of the technical features of this recently completed cable. 800 w. Electn, Lond—Nov. 7, 1902. No. 51733 A.

The Military Cable System of the Philippines. Edgar Russel. Describes the conditions under which the work was carried out by the U. S. Signal Corps. Ill. 3800 w. Trans Am Inst of Elec Engrs—Oct., 1902. No. 52004 D.

The Subterranean Cables to the North. Explains reasons for a continuation of the London and Birmingham line to Manchester and Liverpool, and discusses the difficulties in the replacement of overhead telegraph lines by underground cables. 1400 w. Engr, London—Nov. 14, 1902. No. 51864 A.

Submarine Cable Testing in the Signal Corps, U. S. Army. Townsend Wolcott. An account of the tests made and method of conducting them. 4400 w. Trans. Am. Inst of Elec Engrs—Oct., 1902. No. 52007 D.

Conduits.

Scope, Extent and Construction of the Underground Conduits of the Illinois Telephone and Telegraph Co. in Chicago. George W. Jackson. An illustrated detailed description of the construction work in building conduits to accommodate 100,000 subscribers. Discussion follows. 4800 w. Jour W Soc of Engrs—Oct., 1902. No. 51434 D.

Electrograph.

The Improved Electrograph—A Fac-Simile Telegraph. An account of the improvements made in the machine invented by Herbert R. Palmer and Thomas Mills. Ill. 1800 w. Sci Am—Nov. 15, 1902. No. 51693.

Fire Alarms.

Progress in Fire Alarm Telegraphy. Joseph W. Stover. Extracts from a paper read before the International Assn. of Fire Engrs. Reviews the history and development of this system. 3300 w. Ins Engng—Oct., 1902. No. 51538 C.

Ship Telegraph.

The Electric Automatic Whistle Operator and Telegraph. Illustrates and describes apparatus designed as an adjunct to the ordinary hand pull for opening the valve in the whistle pipe. 1500 w. Marine Engng—Nov., 1902. No. 51651 C.

Signal Corps.

Electricity in the Signal Corps. Samuel Reber. Describes the work of the signal corps, illustrating apparatus used in both field and fortress work. 4000 w. Trans Am Inst of Elec Engrs—Oct., 1902. No. 52009 D.

Space Telegraphy.

A Supplement to Lieut. Solari's Report on "The Radio-Telegraphic Expedition of H. I. M. S. "Carlo Alberto." Nevil Maskelyne. An account of the interference at Porthcurnow at the time of these experiments, with details of interest, and a query as to the possibility of securing privacy. 2400 w. Elect'n, Lond—Nov. 7, 1902. No. 51734 A.

Popp-Branly Aerial Telegraphy Systems. Information concerning a project in Paris to establish a subscribers system covering the city to give the important news of the day. Ill. 1400 w. Sci Am—Nov. 22, 1902. No. 51774.

Radio-Telegraphy (Radio-Telegrafia). Luigi Solari. The official report of the voyages of the Carlo Alberto to Cronstadt and to Spezia, with logs showing the maintenance of wireless communication with the Poldhu Station, and details of the vessel's equipment. 10000 w. 10 plates. Rivista Marittima—Oct., 1902. Supplement. No. 51969 H.

Some Recent Wireless Telegraphy Patents. Illustrated descriptions of inventions patented by Prof. J. A. Fleming and Marconi's Wireless Telegraph Co. 2500 w. Elect'n, Lond—Nov. 14, 1902. Serial, 1st part. No. 51859 A.

The Radio-Telegraphic Expedition of H. I. M. S. "Carlo Alberto." Lieut. Luigi Solari. Gives a map of the course taken, a description of the installation on the vessel, and an account of the experiments, with other information of interest. Ill. 5200 w. Elect'n, Lond—Oct. 24, 1902. No. 51481 A.

The Wireless Telegraph Station at the Hook of Holland (Het Draadlooze Tele-

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graafstation aan den Hoek van Holland). L. Bleekrode. A description of the Ducretet apparatus operating between the Hook of Holland and the lightship Maas, 15 kilometers out. 2000 w. De Ingenieur —Nov. 1, 1902. No. 51961 D.

Wireless Telegraphy—United States Navy. A. M. Beecher. Explains how electric waves are produced, and gives a brief description of the apparatus employed in wireless telegraphy by different inventions. Also reviews what has been accomplished in this field and what is expected in regard to naval vessels. 3000 w. Trans Am Inst of Elec Engrs—Oct., 1902. No. 52002 D.

Telegraphy.

The Rowland Writing Telegraph. Day Allen Willey. An illustrated description of the apparatus and its operation, with editorial. 3300 w. Elec Rev, N Y—Nov. 15, 1902. No. 51712.

The Use and Advantages of the Alternating Current for Land Telegraphy. Edwin F. Northrup. Describes and discusses the fundamental electrical principles involved in applying the alternating current to transmitting telegraphic signals, and in maintaining synchronous motion over long telegraph lines. 4000 w. Elec Wld & Engr— Nov. 8, 1902. Serial. 1st part. No. 51654.

Telephony.

Profitable Telephone Rates. Fred De Land. Discusses the charges of the "Independents" as compared with the experience of the Bell company. Thinks the rates of the former too low to maintain a margin of profit as the business increases. 3800 w. Telephony—Nov., 1902. No. 51504.

The Automatic Telephone and Switchboard. A. E. Kieth and J. F. Crook. Illustrated description of the apparatus with which the immense exchange of the Illinois Telephone and Telegraph Company is to be equipped, stating its advantages. 2700 w. Jour W Soc of Engrs—Oct., 1902. No. 51435 D.

Wireless Telephony. From the *Elektrotechnische Zeitschrift*. A description of the experiments which Herr Ernst Ruhmer made last summer. Ill. 1900 w. Elect'n, Lond—Nov. 7, 1902. No. 51732 A.

DISTRIBUTION.

Converter.

Rotary Converter Set of 150 Horse Power (Drehstrom-Gleichstrom Umformer Gruppe von 150 P. S.) An illustrated description of a rotary converter built by Rieter of Winterthur for the palace at Madrid. A single induction motor drives two continuous-curved generators. 1500 w. Schweiz Bauzeitung—Nov. 8, 1902. No. 51951 B.

Standard Voltage.

The Reasons for the Change of the Navy Standard Voltage from 80 to 125. W. V. N. Powelson. Reviews briefly the history of the voltages used by the navy, and discusses the considerations which led to the recent adoption of 125 volts as the standard for all new installations on board ships. 6000 w. Trans Am Inst of Elec Engrs—Oct., 1902. No. 52005 D.

Switchboards.

Modern Switchboard Practice. H. P. Davis. Illustrates and describes types and systems, discussing their limitations and faults, their operation, protection, etc. 9000 w. St Ry Jour—Nov. 1, 1902. No. 51576 D.

Transformers.

Single Phase Constant Potential Transformers. George T. Hanchett. An explanation of the law of turns and voltages, considering a concrete case. 2500 w. Cent Sta—Nov, 1902. No. 51676.

The Design of Alternating Current Transformers. Harold B. Smith. Information and data to serve as a guide to those not entirely familiar with recent practice in transformer designs. 3700 w. Jour Worcester Poly Inst—Nov., 1902. Serial. 1st part. No. 51770 C.

See also Electrical Engineering, Generating Stations.

ELECTRO-CHEMISTRY.

Accumulators.

The Max Accumulator (Der Akkumulator Max). J. J. Heilmann. The active material is supported on wires of lead and antimony. 1500 w. Elektrochem Zeitschr—Nov., 1902. No. 51941 G.

The Thallium Storage Cell. A. L. Marsh. Describes this cell and compares it with the lead type, noting the points of difference. 2500 w. Elec-Chem Ind—Nov., 1902. No. 51772.

Alkali Industry.

The Present Position of the Electrolytic Alkali Industry. John B. C. Kershaw. The present article gives details of plants in the United Kingdom and in Germany. Ill. 1200 w. Elect'n, Lond—Nov. 14, 1902. Serial. 1st part. No. 51858 A.

Cleveland, O.

Cleveland as a Center in Electrochemical Development. Cecil L. Saunders. Reviews the industries in this field which had their beginnings in this city, and those that grew out of them. 2300 w. Elec Wld & Engr—Nov. 15, 1902. No. 51716.

Electric Furnace.

See Mining and Metallurgy, Iron and Steel.

Electrolysis.

The Electrolysis of Fused Caustic Soda and Potash (Die Elektrolyse von Geschmolzenem Aetznatron und Aetzkali). M. le Blanc and J. Brode. Data and results of experimental work in the laboratory of the Technical High School at Karlsruhe. 2500 w. Zeitschr f Elektrochemie—Oct. 23, 1902. No. 51938 G.

Galvanizing.

The Inspection of Galvanized Iron Articles (Ueber die Beurteilung Verzinkter Eisenwaren). Carl Richter. A comparison of the results of electro-galvanizing with the hot dipping process of zincing, describing methods of test. Serial. Part I. 1800 w. Elektrochem Zeitschr—Nov., 1902. No. 51940 G.

Glass Making.

Electricity in Glass Manufacture. Reviews an article by Dr. Bermbach, published in the *Elektrochemisch Zeitschrift*, discussing the theoretical and practical aspects of the problem, and giving details of the Becker furnace used in experiments in the electrical manufacture of glass made at Cologne. Ill. 2000 w. Sci Am Sup—Nov. 1, 1902. No. 51446.

Hypochlorite.

The Manufacture of Hypochlorite of Soda. Edward Walker. Describes a cell designed by G. J. Atkins of London for electrolyzing solutions of common salt, manufacturing hypochlorite of soda, which is used for bleaching. 600 w. Eng & Min Jour—Nov. 22, 1902. No. 51841.

Ozone.

The Purification of the Atmosphere by Ozone. Ernest T. Williams. Describes the apparatus of J. Harris for purifying the vitiated atmosphere of crowded rooms and buildings and for the sterilization of water, etc., by the use of ozone. Ill. 700 w. Elec Rev, Lond—Nov. 7, 1902. No. 51736 A.

Sault Sainte Marie.

Electrochemistry at Sault Sainte Marie. Joseph W. Richards. Describes the general situation, its facilities for manufacturing and its possibilities in the electrochemical line. Also gives a description of the Rhodin process of manufacturing caustic alkali and bleaching powder, which is installed here. Ill. 3000 w. Elec-Chem Ind—Nov., 1902. No. 51771 C.

Terminology.

Terminology of Primary and Storage Battery Electrodes. A. L. Marsh. Calls attention to the confusion existing on the subject of the polarity of voltaic battery electrodes, and the need of revising the terminology. 2800 w. Elec Wld & Engr —Nov. 15, 1902. No. 51715.

ELECTRO-PHYSICS.

Cathodes.

Distribution of Current at the Surface of Cathodes in Vacuum Tubes. A. Wehnelt. An account of investigations, with illustrations, translated from *Ann. der Physik.* 4800 w. Sci Am Sup—Nov. 8, 1902. No. 51597.

Electric Sparks.

Influence of Electrification on the Electric Spark. Ernst Lecher. From the *Annalen der Physik.* An account of experimental investigations which make it appear certain that the electrification of a spark-gap has a decided influence upon the luminous phenomena. 3000 w. Elect'n, Lond—Nov. 7, 1902. No. 51735 A.

Electric Waves.

On the Reflection of Electric Waves at the Free End of a Parallel Wire System. Henry A. Bumstead. Explains phenomenon observed and its cause. 1500 w. Am Jour of Sci—Nov., 1902. No. 51536 D.

Insulating.

The Application of Insulating Varnish. Arthur B. Weeks. Gives ideas and suggestions from an extended experience. Ill. 1500 w. Steam Engng—Nov. 10, 1902. No. 51643.

Radiography.

The Velocity of Propagation of X Rays (Sur la Vitesse de Propagation des Rayons X). R. Blondlot. Recording experiments similar to those used for determining the velocity of light. 2000 w. Comptes Rendus—Oct. 27, 1902. No. 51943 D.

The Equality of the Velocity of X Rays with that of Light (Sur l'Egalité de la Vitesse de Propagation des Rayons X et de la Vitesse de la Lumière dans l'Aair). R. Blondlot. A record of further experiments, showing the velocity of X rays to be the same as of Hertzian waves and of light in air. 1600 w. Comptes Rendus—Nov. 3, 1902. No. 51944 D.

GENERATING STATIONS.

Alternators.

Armature Reactions and Pendulum Effects in Alternators (Ankerreaktion und Pendelercheinungen bei Drehstromgeneratoren). Rudolf Goldschmidt. A graphical and analytical discussion of the reactions in alternator armatures. 1800 w. Elektrotech Zeitschr—Nov. 6, 1902. No. 51935 B.

Some Noteworthy Rotor Construction (Eine Bemerkens Magnetradekonstruktions). F. Tischendörfer. With photographs of portions of large alternators, showing the mannar in which the rotor is built in connection with the fly wheel. 1500 w. Zeitschr d Ver Deutscher Ing—Nov. 8, 1902. No. 51918 D.

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The Coupling of Alternators (Note sur le Couplage des Alternateurs). L. Martin. With diagrams showing the method of arranging alternators in step for operation in parallel. 2000 w. Revue Technique—Nov. 10, 1902. No. 51911 D.

Bordeaux.

Central Power Station of the Central Railway of France at Bordeaux-Saint-Jean. ? A. Laurent. An illustrated description of the central power plant at Bordeaux where 1500 horse power is generated and electrically distributed. 3500 w. 2 plates. Rev Gen des Chem de Fer —Nov., 1902. No. 51927 H.

Cambridge, Mass.

Power Plant of the Cambridge Electric Light Company, Cambridge, Mass. Illustrates and describes this recently completed plant. It is an alternating-current one with a three-phase 60-cycle supply furnished from direct-connected vertical compound condensing generating units. 3200 w. Eng Rec—Nov. 4, 1902. No. 51582.

Commutation.

A Contribution to the Theory of Commutation. Alexander Rothert. Translated from the *Elektrotechnische Zeitschrift.* 2500 w. Elec Engr, Lond—Nov. 14, 1902. Serial. 1st part. No. 51854 A.

Sparkless Commutation (Ueber Funkenfreies Kommutiren). P. Prenzlin. A discussion of the arrangement of the carbon brushes of a continuous current dynamo so as to secure sparkless commutation when running in either direction. Two articles. 7500 w. Elektrotech Zeitschr—Oct. 23, 30, 1902. No. 51931 each B.

Special-Shaped Magnet Poles and the Way They Affect Commutation. Fred W. Davies. Describes the principal ways in which the shape of the cores and pole-pieces of continuous-current machines have been modified in order to make sparkless commutation easier, and thus permit of a more economical design. Ill. 1800 w. Elec Rev, Lond—Nov. 14, 1902. No. 51855 A.

Compounding.

Automatic Regulators, and the Compounding of Generating Sets (Les Régulateurs Automatiques et le Compoundage Electromécanique des Groupes Electrogènes). J. L. Routin. Discussing the combination of mechanical and electrical regulation in compounding. 10000 w. Bull Soc Int d Electriciens—Aug., Sept., Oct., 1902. No. 51947 each H.

Destructors.

See Civil Engineering, Municipal.

Dynamos.

Design of Continuous Current Dynamos. Henry A. Mavor. Read before the Glasgow Sec. of the Inst. of Elec. Engrs. Considers the application of results of calculations and experiments to practical design. 4000 w. Mech Engr—Nov. 15, 1902. No. 51849 A.

Hydro-Electric Stations.

A Large French Electrical Power Distribution Scheme. An illustrated description of the plant at Saint Georges, near Narbonne, utilising a fall of 100 meters. The power is transmitted 40 kilometers. 2500 w. Elect'n, Lond—Nov. 14, 1902. No. 51857 A.

Canadian Niagara Power Co.'s Development. An illustrated account of the work under construction by this company which will generate 110,000 electrical horse power. 2000 w. Can Engr—Nov., 1902. No. 51634.

Recent European Water Power Plant. An illustrated description of several plants given in a recent paper before the Engineers & Architects Assn. of Zurich, by Mr. Zoelly. 1600 w. Eng Rec—Nov. 15, 1902. No. 51720.

The Generating Station at Champ (L 'Usine Génératrice de Champ). A. Lépine. A fully illustrated description of the hydro-electric station situated on the river Drac near Grenoble, France, more than 4000 h. p. are developed and distributed. 6000 w. Bull Soc Int d Electriciens—Aug., Sept., Oct., 1902. No. 51946 each H.

The Hydro-Electric Station at Vouvry, Switzerland (Usine Hydro-Electrique de Vouvry, Suisse). Describing the electric station above Villeneuve, in which the water of Lake Tanay is utilized under a head of 950 metres. 2000 w. 1 plate. Genie Civil—Oct. 18, 1902. No. 51900 D.

The Power Plant and Transmission for the City of Lausanne, Switzerland (Die Kraftübertragung für die Stadt Lausanne.) Dr. Wyssling. Illustrating the plant in which 5,000 horse power is transmitted by continuous current from St. Maurice to Lausanne, a distance of 55 kilometres. Serial. Part I. Elektrotech Zeitschr—Nov. 13, 1902. No. 51936 B.

The Electric Plants of Switzerland (Die Elektrizitätswerke der Schweiz). Richard Lorenz. With map showing the extent to which the hydraulic resources of Switzerland are utilized; more than 160,000 h. p. are developed. 1500 w. 1 map. Zeitschr f Elektrochemie—Oct. 30, 1902. No. 51939 G.

Power Development at Niagara Falls. A. A. Bowman. Describes the Canadian power development at Niagara Falls principally. 3000 w. Can Engr—Nov., 1902. No. 51635.

Loads.

On What Lines Shall We Reach New Business to Improve Our Load Curve and Increase Our Net Earnings? George Hay-

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ler, Jr. Read at Cleveland meeting of the Ohio Elec. Lgt. Assn. Suggestions from the standpoint of stations operating from dusk to daylight and supplying light only. 1500 w. Elec Rev, N Y—Nov. 8, 1902. No. 51645.

Loads on Electric Stations. Alton D. Adams. Curves and data illustrating the changes of energy outputs from month to month of different supply systems; also illustrates the variations in the ratio of average to maximum loads. 2000 w. Elec Rev, N Y—Nov. 8, 1902. No. 51644.

Midland.

The Midland Electric Power Station. Illustrations and information concerning the development of electric power distribution for lighting and traction work at Ocker Hill. 2500 w. Engng—Nov. 14, 1902. No. 51866 A.

Power House.

See Street and Electric Railways.

Rates.

The Determination of Central Station Rates. C. J. Spencer. Considers the several systems of charging for current. 900 w. Elec Wld & Engr—Nov. 22, 1902. No. 51810.

Richmond, Ind.

The Municipal Lighting and Power Plant of Richmond, Ind. Illustrated detailed description. 2500 w. Engr, U S A —Nov. 1, 1902. No. 51514.

St. Louis, Mich.

The Water and Lighting Plant at St. Louis, Mich. Brief description of a combined water-works pumping station and electric lighting plant capable of being operated either separately or together, and run by both water and steam power. 1400 w. Eng Rec—Nov. 15, 1902. No. 51723.

LIGHTING.

Arcs.

Experiments upon Alternating Current Arcs at High Pressure (Untersuchungen über den Wechselstromlichtbogen bei Höherer Spannung). Berthold Monasch. Giving curves, showing the results of experiments in dry air and in vacuo for arcs of various lengths. 1800 w. Elektrotech Zeitschr—Oct. 30, 1902. No. 51933 B.

Nernst Lamp.

A Recent Advance in Electric Lighting. A study of the Nernst lamp. 3500 w. Elec Rev, N Y—Nov. 15, 1902. No. 51713.

Street Lighting.

Electric Street Lighting. Alex. Dow. Read before the Am. Soc. of Munic. Imp. Considers methods, costs, and municipal ownership of street lighting plants. 3500 w. Munic Engng—Nov., 1902. No. 51543 C.

MEASUREMENT.

Cathode Rays.

The Measurement of Bodies Smaller Than Atoms. S. N. Taylor. An explanation of how the masses and velocities of the particles which constitute cathode rays are measured. 3200 w. Elec Wld & Engr —Nov. 15, 1902. No. 51714.

Instruments.

Faults of Electrical Measuring Instruments and Their Correction. H. Williams. Discusses the general class of troubles common to most types, and their remedy. 2500 w. Am Elect'n—Nov., 1902. No. 51604.

Magnetometer.

A Compensation Magnetometer (Kompensations-Magnetometer). Dr. Max Corsepius. Describing an improved instrument for the practical determination of the magnetic properties of various kinds of iron. 1800 w. Elektrotech Zeitschr—Nov. 13, 1902. No. 51937 B.

Permeability.

The Permeability of Magnetic Liquids. Fitzhugh Townsend, S. Diamant, and L. S. Thurston. Describes a method of measuring the permeability which involves practically the same idea as the Hughes balance. 700 w. Elec Wld & Engr—Nov. 22, 1902. No. 51809.

Speed-Time Curves.

Notes on the Plotting of Speed-Time Curves. C. O. Mailloux. Notes of theoretical and practical observations bearing upon the analysis of the speed-time curve, or the study of its characteristics, and upon its synthesis, or the principles involved in plotting it, with a view to facilitating its use as a "method of precision." 27600 w. Trans Am Inst of Elec Engrs—Aug. & Sept., 1902. No. 51627 D.

Testing.

Practical Dynamo and Motor Testing. Charles F. Smith. Describes the method of carrying out a number of typical tests and measurements, pointing out some conclusions to be drawn from the results. 2500 w. Mech Engr—Nov. 8, 1902. Serial. 1st part. No. 51730 A.

Wattmeter.

The Olivetti Indicating and Recording Wattmeter (Wattmètre Indicateur et Eurégistreur Olivetti). A. Bainville. An auxiliary motor, controlled by the indicating wattmeter, operates the recording apparatus. 2000 w. Electricien—Nov. 8, 1902. No. 51977 B.

POWER APPLICATIONS.

Cement Mill.

Electric Apparatus in a Modern Cement Mill. An illustrated description of the application of electric apparatus to severe

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conditions with entire success. 2200 w. Elec Rev, N Y—Nov. 1, 1902. No. 51470.

Cranes.

Notes on Crane Design—Solenoids. A. D. Williams. On the use of solenoids in electric hoisting appliances. Gives manner of working at a solenoid to suit an assumed case. 2800 w. Am Mach—Nov. 20, 1902. No. 51784.

Notes on Crane Design. A. D. Williams. Wiring diagram and particulars relating to the electrical equipment of cranes. 1000 w. Am Mach—Nov. 27, 1902. No. 52025.

Electric Driving.

Electric Power Applications in Modern Steel Making. John Hays Smith. Describing especially the numerous applications of electric driving in the Edgar Thomson mills of the Carnegie Company. 3500 w. Engineering Magazine—Dec., 1902. No. 51996 B.

Elevators.

Electric Elevator Control Systems. H. D. James. Illustrates and describes the fundamental features of some of the representative types of electric elevator control. 2200 w. Am Elect'n—Nov., 1902. No. 51602.

Food Plant.

Electrically Operated Food Plant at Niagara Falls. Frank C. Perkins. An illustrated description of the Natural Food plant. Both alternating and continuous currents are utilized, and also a storage battery. 1800 w. Elec Rev, N Y—Nov. 22, 1902. No. 51793.

Hat Factory.

Electrical Equipment of a Large Hat Factory. Illustrated detailed description of the power plant of the John B. Stetson Company, at Philadelphia. 1800 w. Am Elect'n—Nov., 1902. No. 51601.

Mine Hoist.

Electrically Driven Mine Hoist (Elektrisch Betriebene Fördermaschinen). Illustrating and describing the Ilgner-Siemens-Halske system as exhibited at Düsseldorf. 4000 w. Elektrotech Zeitschr—Oct. 30, 1902. No. 51934 B.

Electric Winding Machine for Colliery Work. From *Glückauf*. Illustrated description of an electric winding engine designed by Tr. Buschmann. 900 w. Col Guard—Oct. 24, 1902. No. 51483 A.

Mining Plant.

Electric Drainage Plants (Installations Electriques à Epuisement). J. Loubat. A discussion of the applicability of electric power to the operation of mine pumps. 4000 w. Revue Technique—Oct. 25, 1902. No. 51908 D.

Electric Power on the Comstock. Gives an outline of the history of this noted mine, and a description of the plant supplying electric power for mining and for railway transportation of the raw material. 2500 w. Engng—Oct. 24, 1902. No. 51484 A.

Electrical Equipment of the C. & C. Shaft of the Consolidated California & Virginia Mining Co., Virginia City, Nev. Leon M. Hall. Illustrated description. 1800 w. Mines & Min—Nov., 1902. No. 51560 C.

Electric Transmission Plant at a Lead Mine. Illustrates and describes the complete three-phase electrical equipment installed in a mine in Wales. 500 w. Prac Engr—Nov. 7, 1902. Serial. 1st part. No. 51729 A.

Mine Pumping.

Electric Mine Pumping at the Montreal Shaft of the Roche-la Moliere and Firminy Mining Company. Frank C. Perkins. Illustrated description of the plant and its operation. 2000 w. Min Rept—Nov. 6, 1902. No. 51632.

Motors.

An Asynchronous Motor with Power-Factor Equal to Unity. A. S. McAllister. A statement of the advantages of the induction motor, with a description of the Heyland motor. 2500 w. Sib Jour of Engng—Nov., 1902. No. 52021 C.

Electric Motors with Variable Speed (Moteurs Electriques à Vitesse Variable). A description of the induction and continuous current motors made by the Oerlikon Company of Switzerland. 1800 w. Génie Civil—Oct. 18, 1902. No. 51901 D.

Polyphase Motors with Four Speeds (Vierstufiger Drehstrommotor). Dr. Hans Behn-Eochenburg. A description of the improved polyphase motors of the Oerlikon works, having speeds of 500, 750, 1,000 and 1,500 revolutions; also continuous current motors with speeds from 350 to 1,600 revolutions. 2000 w. Schweiz Bauzeitung—Oct. 18, 1902. No. 51949 B.

TRANSMISSION.

India.

The Cauvery Power Transmission. Illustrates and describes this interesting transmission in India by which power is transmitted from Cauvery Falls to the Kolar gold fields, a distance from 90 to 100 miles. 3400 w. Elec Engr, Lond—Oct. 31, 1902. No. 51614 A.

Lightning Arresters.

The Protection of Overhead Lines Against Lightning (La Protection des Lignes Aériennes Centre la Fondre). E. Dussaugey. An exhaustive study of the construction and operation of devices for protecting electric transmission lines from

lightning. 8000 w. Bull Soc Int Electriciens—Aug., Sept., Oct., 1902. No. 51-945 each H.

Pike's Peak.

The Pike's Peak Power Plant. An illustrated description. 3000 w. Eng & Min Jour—Nov. 8, 1902. No. 51657.

See also Electrical Engineering, Generating Station.

MISCELLANY.

Address.

Proposed Developments of the Institute. Charles F. Scott. Presidential address delivered at New York. September 26, 1902. Considers the present standing and future possibilities of the Institute. 4800 w. Trans Am Inst of Elec Engrs—Aug. & Sept., 1902. No. 51630 D.

Discussion.

Papers by Charles P. Steinmetz, Dr. Samuel Sheldon, Prof. R. B. Owens, Prof. William Esty, Mr. Harold W. Buck, and Mr. R. B. Raymond, at Great Barrington, Mass. Papers on the education of electrical engineers. 13000 w. Trans Am Inst of Elec Engrs—Aug. & Sept., 1902. No. 51629 D.

Military Application.

Civilian Co-operation in the Development of Electrical Devices for Military Purposes. Caryl D. Haskins. An appeal for closer co-operation between civilian engineers and the officers of the U. S. Navy and Army in the development of electrical applications. 1200 w. Trans Am Inst of Elec Engrs—Oct., 1902. No. 52000 D.

Electricity in Its Application to Submarine Mines. John Stephen Sewell. Reviews the objects desirable to accomplish by such a plant, the electrical arrangements and apparatus, testing, etc. 2300 w. Trans Am Inst of Elec Engrs—Oct., 1902. No. 52001 D.

Electricity in Permanent Seacoast Defenses. George W. Goethals. Explains the conditions of a military post on the coast, and the requirements of the electrical installation and its growing demands. 6500 w. Trans Am Inst of Elec Engrs—Oct., 1902. No. 52006 D.

Electricity in the Navy. Walter M. McFarland. Remarks mainly with respect to power plants and motor installations on shore, with brief reference to electrical apparatus on war vessels. 3400 w. Trans Am Inst of Elec Engrs—Oct., 1902. No. 52008 D.

Electricity in the Navy. Harry George. Sketches the development and applications in the naval service for both lighting and power, and compares the United States vessels with foreign navies. Ill. 13500 w. Trans Am Inst of Elec Engrs—Oct., 1902. No. 52003 D.

Emergency Engineering for Harbor Defense. Dr. Louis Bell. A brief review of work during the Spanish-American war in the harbor at Boston, and the lessons learned. 3500 w. Trans Am Inst of Elec Engrs—Oct., 1902. No. 52010 D.

The Probable Future Developments in the Use of Electricity on Board Ships. F. O. Blackwell. Points out the improvements in sight in marine electric plants, the field for their profitable extension, and some of the recent developments in electrical engineering that may be advantageously employed on shipboard. 6600 w. Trans Am Soc of Nav Archts & Marine Engrs, No. 13—Nov., 1902. No. 51805 D.

Review.

Electrical Progress, 1877-1902. Thomas Commerford Martin. Brief review of a period which, with the exceptions of telegraphy and telephony, covers most of the practical applications of electricity, and showing its relation to mechanical engineering. 2000 w. Am Mach—Nov. 6, 1902. No. 51554.

GAS WORKS ENGINEERING

Burners.

The Care and Maintenance of Incandescent Gas Burners. McDougald Dexter. Presented at the meeting of the Am. Gas. Lgt. Assn. Suggestions as to their proper care and maintenance, the importance of inspection, renewals, etc. 2500 w. Am Gas Lgt Jour—Nov. 3, 1902. No. 51497.

Coke.

Gleanings from Coke-Oven Practice. Abstract Translation of paper by Herr Hilgenstock, before the German Assn. of Gas & Water Engrs. 4000 w. Jour Gas Lgt—Oct. 28, 1902. No. 51607 A.

Compressed Gas.

The Compressed Gas Industries. Editorial discussion of points concerning the manufacture and sale of compressed oxygen and carbonic acid. 1200 w. Engng—Oct. 31, 1902. No. 51622 A.

Fuel Gas.

Gases Used Industrially as Fuels. Abstract translation of an article by Dr. Mes-

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serschmidt, in the *Zeitschrift für Angewandte Chemie*. 1300 w. Jour Gas Lgt—Oct. 21, 1902. No. 51474 A.

Gas Engineers.

The Rise and Recognition of the Engineer. Leon P. Lowe. Read before the Pacific Coast Gas Assn. The part of the engineer in the advancement of the world, especially referring to gas engineering. 2700 w. Jour of Elec—Nov., 1902. No. 51891 C.

Ignition.

New Electrical Gas Ignition and Extinguishing Device. Illustrates and describes a device being introduced in England. 1500 w. Jour Gas Lgt—Oct. 21, 1902. No. 51472 A.

Mantles.

The Making of Welsbach Mantles. An account of the processes through which the mantle has to pass, with an illustrated description of the new factory at Wandsworth, England, built for the sole purpose of producing these mantles. 5300 w. Jour Gas Lgt—Oct. 21, 1902. No. 51471 A.

The New Plaissetty Mantle—A Strong Competitor. Describes the process of manufacture of this mantle and reports tests made. Ill. 3800 w. Jour Gas Lgt—Oct. 28, 1902. No. 51605 A.

Naphthalene.

Further Suggestions for the Elimination of Naphthalene from Coal Gas. Thomas Glover and William Young. Read before the So. Dist, Assn. of Gas Engrs & Mgrs. (England). Presents some considerations of the problem and proposes modifications in the methods of condensation which will effectually reduce the quantity of naphthalene in the finished gas. 4900 w. Gas Wld—Nov. 8, 1902. No. 51726 A.

Natural Gas.

Natural Gas in 1901. Extracts from the Mineral Resources of the United States for 1901. 2500 w. Pro Age—Nov. 15, 1902. No. 51684.

Oldham.

New Gas-Producing Plant at Oldham. An illustrated general description of extensions comprising a retort house, coal-store and plant regenerative settings, and compressed air stoking machinery. 3200 w. Jour Gas Lgt—Oct. 28, 1902. No. 51606 A.

Power Gas.

Producer Gas Plants (Sauggeneratorgasanlagen). Adolf Langen. A discussion of recent forms of producers for the generation of lean gas for use in gas engines. 3500 w. Zeitschr d Ver Deutscher Ing—Nov. 8, 1902. No. 51917 D.

Purifying.

Grid-Valves. R. J. Milbourne. Remarks on the similarity of the Millbourne gas-purifier valve and those invented by Heer Prins van Doesburgh. Gives illustrations of the Milbourne grid-valve with explanation. 1600 w. Jour Gas Lgt—Oct. 21, 1902. No. 51473 A.

Retorts.

Concerning Mr. R. B. Brown's Paper, "Why Milwaukee Did Not Build Inclines." Frederick Egner. A criticism of statements made in paper read before the Am. Gas Lgt. Assn. 1200 w. Jour Gas Lgt—Nov. 11, 1902. No. 51811 A.

Discussion on the Paper by R. B. Brown of Milwaukee, Wis., as to "Why Milwaukee Did Not Build Inclines." Discussion at meeting of the Am. Gas Lgt. Assn. 5400 w. Am Gas Lgt Jour—Nov. 24, 1902. No. 51835.

Why Milwaukee Did Not Build Inclines. R. B. Brown. Read before the Am. Gas Light Assn. States the conditions affecting the carbonization scheme at Milwaukee and explains why the inclined retort system was not considered an economic success. 4600 w. Am Gas Lgt Jour Nov. 17, 1902. No. 51763.

INDUSTRIAL ECONOMY

Accident Prevention.

See Mechanical Engineering, Machine Works and Foundries.

Address.

Andrew Carnegie's Rectorial Address. Extracts from an address delivered at St. Andrews University, Scotland, on the subject of "Europe vs. America." 2200 w. Ir Age—Oct. 30, 1902. No. 51443.

North Staffordshire Institution of Mining and Mechanical Engineers. Presidential address of A. M. Henshaw, discussing the coal and iron industry of Great Britain in comparison with the United States, deep mining, waste of fuel, electricity, blast furnace gas, etc. 5800 w. Ir & Coal Trds Rev—Oct. 24, 1902. No. 51488 A.

America.

What We May Learn from America (Was wir von Amerika lernen Können). H. von Schwabe. A review of the development of the coal and iron production of America, and the cost of transport,

with lessons to be gained for Europe. 2500 w. Stahl u Eisen—Nov. 15, 1902. No. 51955 D.

Coal Strike.

Conditions of Labor and Life in Anthracite Coal Mining. Frederick L. Hoffman. Considers 1st, Wages, actual earnings and hours of labor. 2nd, Economic conditions, family expenditures, cost of living, savings, pauperism, etc. 3rd, Health and mortality accident liability, and the waste of productive life and resulting social misery. 2000 w. Eng & Min Jour—Nov. 22, 1902. Serial. 1st part. No. 51838.

Principles Involved in the Settlement of the Coal Strike. Editorial discussing the rights of fair wages and individual liberty. 1200 w. Eng News—Oct. 30, 1902. No. 51451.

The Anthracite Coal Strike Commission. Report of proceedings giving abstracts of several of the statements presented by the companies. 2000 w. Eng & Min Jour—Nov. 22, 1902. No. 51839.

The Labor Problem of the Anthracite Coal Mines. Editorial discussion of the demands made by the recently striking miners, especially the question of wages, outlining a method for improving the conditions. 2800 w. Eng News—Nov. 13, 1902. No. 51687.

The Reply of the Anthracite Mine Operators. Gives the reply to the demands of John Mitchell in behalf of the United Mine Workers of America, and discusses the same. 2000 w. Eng News—Nov. 20, 1902. No. 51823.

The Settlement of the Coal Strike. Walter Wellman. A discussion of the lessons of the strike and the effect upon capital and labor. 3700 w. Rev of Revs—Nov., 1902. No. 51466 C.

Coal Trade.

The Course of the Retail Coal Trade. Dr. David T. Day. An outline of the past and prospective course of the retail coal trade, giving an explanation of the effect of the recent strike, the cost of transportation, and the price of coal at various points. 2700 w. Nat Geog Mag—Nov., 1902. No. 51696 C.

Corea.

The Economic Situation and Mineral Riches of Corea (La Corée sa Situation Economique et ses Richesses Minières). G. Braecke. A general review of the mineral resources of Corea with statistics for 1899 and 1900. 10,000 w. Rev Univ des Mines—Sept., 1902. No. 51929 H.

Cost Keeping.

Cost-Finding Methods for Moderate Sized Shops. H. L. Arnold. The present article deals with the methods of the Bigelow Company, of New Haven, Conn., employing about 200 men in the manufacture of steam boilers. 3000 w. Engineering Magazine—Dec., 1902. No. 51993 B.

Education.

Armour Institute of Technology, Chicago. An illustrated description of the buildings and their equipment, with remarks on the scope of the instruction. 3200 w. Steam Engng—Nov. 10, 1902. No. 51641.

Manchester School of Technology. Illustrated description of this recently completed school in England, the erection and equipment having occupied seven years. 3000 w. Elec Rev, Lond—Oct. 31, 1902. No. 51615 A.

Technical Education in the University of London. J. D. Cormack. Considers some of the needs of the engineering department, the value of scientific training, etc. 5000 w. Engng—Oct. 31, 1902. No. 51624 A.

The Training of Engineers at an American University. Frank Fayant. An illustrated description of the work at Cornell University. 3000 w. Engr, Lond—Nov. 14, 1902. No. 51863 A.

Fritz Medal.

The Foundation of the John Fritz Medal. An editorial comment on the significance of this important foundation, with illustrations of the medal and portrait of Mr. Fritz. 1000 w. Engineering Magazine—Dec., 1902. No. 51995 B.

Industrial Progress.

A Review and a Glance Forward. John E. Sweet. Notes the progress of the last 25 years, and the future outlook in machine tools. 1500 w. Am Mach—Nov. 6, 1902. No. 51552.

The Retrospect of a Quarter-Century of Progress. Robert H. Thurston. A review of the advance made in technical education and work, especially in America, and the part taken by this paper in the work. 2700 w. Am Mach—Nov. 6, 1902. No. 51549.

Labor-Trusts.

Labor-Trusts the Worst. Robert S. Minot, in the Boston *Transcript*. A presentation of the rights and principles involved in labor disturbances. 1000 w. Am Archt—Nov. 1, 1902. No. 51465.

Municipal Ownership.

Municipal Ownership. Frank J. Symmes. Read before the Pacific Coast Gas Assn. A discussion of this subject not favorable to public ownership. 5700 w. Jour of Elec—Nov., 1902. No. 51889 C.

Reichsanstalt.

The Work of the Reichsanstalt in the year 1901. Summary of the official report

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on the work of the Physikalische Technische Reichsanstalt. 5000 w. Engng—Oct. 31, 1902. No. 51619 A.

Trusts.

The Growth of Trust Companies. Charles A. Conant. Discusses the striking growth shown in the United States, their management, privileges, etc. 5000 w. Rev of Revs—Nov., 1902. No. 51467 C.

Wages.

Gift Propositions for Paying Workmen. Frank Richards. Discusses the Premium Plan and the Bonus System, and gives the writer's views. 3000 w. Trans Am Soc of Mech Engrs, No. 0966—Dec., 1902. No. 51877.

The Real Economy of a High Wage Rate. Percy Longmuir. A discussion of the effect of a high wage rate as a stimulus to the industry and capacity of skilled workers, and hence as an undoubted source of economy to the employer. 3000 w. Engineering Magazine—Dec., 1902. No. 51994 B.

Wastes.

The Utilization of Wastes and By-Products in Manufactures. Henry C. Kittredge. A report with special reference to the decade from 1890-1900. Reviews refuse wastes, the by-products of the iron and steel industry, and lumber and timber products in the present article. 4800 w. Sci Am Sup—Nov. 15, 1902. Serial. 1st part. No. 51700.

MARINE AND NAVAL ENGINEERING

Armor Trials.

Armor, Projectiles, and Military Explosives. Charles C. Jamieson. A review of important experiments made with projectiles and armor, illustrating various devices, and giving an account of the experiments with Gathmann's shell which won the victory for projectiles. Ill. 5800 w. Jour W Soc of Engrs—Oct., 1902. No. 51432 D.

Battleship.

The Austrian Battleship Babenburg. Illustration and description of the last of a trio of vessels building, with comparison with modern vessels of about the same size. 1700 w. Engr, Lond—Nov. 7, 1902. No. 51749 A.

The Preliminary Official Trial of the U. S. Battleship Maine. J. W. Powell. A description of the vessel with report of tests. Illustrated by 12 plates. 3500 w. Trans Am Soc of Nav Archts & Marine Engrs, No. 4—Nov., 1902. No. 51797 D.

U. S. Battleship Maine. D. S. Mahony. Illustration with detailed description of the vessel and its equipment, and report of trial. 5000 w. Jour Am Soc of Nav Engrs—Nov., 1902. No. 51896 H.

Boilers.

See Mechanical Engineering, Steam Engineering.

Cavitation.

Cavitation in Screw Propellers (Sur la Cavitation dans les Navires à Hélices). J. A. Normand. A study of the action of screw propellers, deducing the conditions of maximum efficiency. 1800 w. Comptes Rendus—Oct. 27, 1902. No. 51942 D.

Coaling.

Supplying Combustible at Sea (Riformimento di Combustibile in Mare). E. Ferretti. A discussion of the importance of coaling war ships from colliers at sea, with reference to the Miller cable conveyor. 6000 w. Rivista Marittima—Oct., 1902. No. 51967 H.

Cruisers.

Cruiser Design. Editorial discussion of the new British cruisers of the Duke of Edinburgh class. 1700 w. Engng—Nov. 14, 1902. No. 51867 A.

The New Armored Cruisers. The majority and minority reports of the Board of Construction of the U. S. Navy Department. 2000 w. Naut Gaz—Nov. 6, 1902. No. 51640.

Designs.

Remarks on the New Designs of Naval Vessels. Francis T. Bowles. Remarks on time required to construct naval vessels, the size, offensive and defensive power, with comparisons. Also particulars of U. S. battleships Nos. 18 & 19, Connecticut and Louisiana. 2 plates. 2500 w. Trans Am Soc of Nav Archts & Marine Engrs, No. 11—Nov., 1902. No. 51803 D.

Destroyers.

Description and Trials of the U. S. Destroyers Truxton. Whipple, and Worden. John D. Ford. Illustrates the engine and gives detailed description and report of trials. 5600 w. Jour Am Soc of Nav Engrs—Nov., 1902. No. 51895 H.

Trials of the United States Torpedo-Boat Destroyers Bainbridge, Barry and Chauncey. Tabulated results and conditions of the trials which were successfully passed, with illustrations and remarks. 1000 w. Marine Engng—Nov., 1902. No. 51647 C.

U. S. Torpedo-Boat Destroyers Bainbridge, Barry, and Chauncey. Jas. Nelson Alexander. An illustrated detailed de-

scription of these vessels and their equipment, with report of trials. 8300 w. Jour Am Soc of Nav Engrs—Nov., 1902. No. 51893 H.

Disaster.

The Bullfinch Disaster. Some interesting information as to the cause of the accident which occurred on the torpedo-destroyer Bullfinch, brought out in a recent court decision. 3300 w. Engr, Lond—Nov. 7, 1902. No. 51748 A.

Electricity.

See Electrical Engineering, Miscellany.

Engines.

See Mechanical Engineering, Steam Engineering.

Ferry-Boat Trials.

Progressive Trials of the Screw Ferry-Boat Edgewater. E. A. Stevens and C. P. Paulding. Presents results of the trials of interest to designers. 2000 w. Trans Am Soc of Nav Archts & Marine Engrs, No. 2—Nov., 1902. No. 51795 D.

Fire Boat.

Fire, Tug, and Police Boat for the Mexican Government. Illustrated description of the "Triton," the second and larger of two vessels of the same type for the Mexican government. 1000 w. Engng—Oct. 24, 1902. No. 51485 A.

Flexure.

The Flexure of Ships (Sul Varo delle Navi). Adolfo Wehmeyer. A graphical study of the pressures upon a ship's hull under varying conditions, with the corresponding flexures produced. Serial, Part I. 6000 w. 2 plates. Rivista Marittima—Oct., 1902. No. 51968 H.

Large Ships.

The Economy of Large Ships. A. W. Robinson. Considers the limitations that govern the increase in size, the present stage of development, and the future outlook. 2800 w. Can Soc of Civ Engrs—Adv. proof—Nov., 1902. No. 51529 D.

Launch.

The Launch of the Kaiser Wilhelm II. (Le Lancement du Kaiser Wilhelm II.). J. Bosquet. With illustrations showing the details of the launch of this large steamship, including the friction brakes by which the momentum of the hull was checked. 1800 w. Genie Civil—Nov. 8, 1902. No. 51907 D.

Life Boat.

Engelhardt's Collapsible Life Boat. An illustrated description of a boat which occupies but little space, and is available for instant use. 1300 w. Am Shipbuilder—Nov. 20. No. 51791.

Lighthouses.

The New American Lighthouse System. George Ethelbert Walsh. An interesting account of the efficient lighthouse service, consisting of some 9,000 warning lights and signals. 1600 w. Sci Am—Nov. 22, 1902. No. 51773.

Liquid Fuel.

Oil Fuel for the Navy. The report of the Special Board on tests of liquid fuel for naval purposes. Gives particulars of tests made. 8000 w. Ir Age—Oct. 30, 1902. No. 51442.

Use of Liquid Fuel. A review of Rear-Admiral Melville's report, and the experiments conducted by the United States Navy. 9800 w. Marine Rev—Nov. 13, 1902. No. 51703.

Monitor.

Description and Trials of the U. S. Monitor Arkansas. C. K. Mallory. 2800 w. Jour Am Soc of Nav Engrs—Nov., 1902. No. 51899 H.

Naval Engineering.

Naval Engineering Advance. Its Influence upon Sea Power. George W. Melville. Considers the enginering advance along maritime and naval lines, discussing important achievements. 4800 w. Am Mach—Nov. 6, 1902. No. 51550.

Naval Engineers.

The Engineer's Branch of the Navy. Lieut. Carlyon Bellairs. Facts concerning the position of the officers and chief petty officers, the growth in numbers, and other information given in tabular and graphical form. 1300 w. Engr, Lond—Nov. 7, 1902. No. 51746 A.

Ordnance.

Naval Ordnance. A review of an interesting report of Admiral Charles O'Neil. 3800 w. Ir Age—Nov. 6, 1902. No. 51570.

The Development of Modern Ordnance and Armor in the United States. Charles O'Neil. A review of the prominent facts in connection with the development and manufacture showing progress made. 17000 w. 2 plates. Trans Am Soc of Nav Archts & Marine Engrs, No. 10—Nov., 1902. No. 51802 D.

The Tactics of the Gun. A. P. Niblack. A discussion of modern gunnery on battleships, the positions of guns, and the object of tactical manoeuvres, etc. 3 plates. 3000 w. Trans Am Soc of Nav Archts & Marine Engrs, No. 12—Nov., 1902. No. 51804 D.

Pipe Joints.

See Mechanical Engineering, Steam Engineering.

Repair Ship.

The Repair Ship a Military Auxiliary to the Naval Fleet in Peace and War. F. W. Bartlett. References to the work of the

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Vulcan during the Spanish-American war, with an explanation of the many ways such a ship can be made of value in times of peace. Also outlines the general scheme of such a ship. 19000 w. Jour Am Soc of Nav Engrs—Nov., 1902. No. 51894 H.

Salvage.

"Saivage." C. M. Holmes. Paper read before the Insurance Inst. of Victoria, Aust. A brief statement of the law in regard to civil salvage. 3500 w. Aust Min Stand—Sept. 18, 1902. Serial, 1st part. No. 51479 B.

Schooner.

Mechanical Equipment of a Seven-Masted Schooner. Illustrates and describes the machinery on the "Thomas W. Lawson." 1500 w. Marine Engng—Nov., 1902. No. 51648 C.

The Seven-Masted Schooner—In General and in Detail. Henry P. Jones. An illustrated description of the "Thos. W. Lawson," the latest example of this type of vessel, with remarks on the present standing of sailing vessels in the American merchant marine. Also editorial. 4800 w. Eng News—Nov. 6, 1902. No. 51592.

Shipbuilders.

Technical Training for Shipbuilders. Henry S. Pritchett. Gives the conclusions of those in charge of the teaching of naval architecture and ship design at the Massachusetts Inst. of Technology regarding the instruction desirable. 3200 w. Trans Am Soc of Nav Archts & Marine Engrs, No. 1—Nov., 1902. No. 51794 D.

Shipbuilding.

Why It Takes So Long Time to Build and Equip a Naval Vessel for the United States. George W. Dickie. Points out the chief causes of delay in building these vessels, introducing a discussion on methods of design and construction. 4000 w. Trans Am Soc of Nav Archts & Marine Engrs, No. 3—Nov., 1902. No. 51796 D.

Shipping.

The Cunard Agreement. W. R. Lawson. A discussion of the British agreements with the Cunard Company, and the Shipping Combine established by J. Pierpont Morgan; the agreement with the German government, etc. 5800 w. Contemporary Rev—Nov., 1902. No. 51705 D.

Ship Telegraph.

See Electrical Engineering, Communication.

Stability.

Some Problems on the Surfaces of Buoyancy and of Water Lines. C. H. Peabody. A study of the geometry of the surfaces of buoyancy and water-lines as related to the stability of ships. 7500 w. Plate. Trans Am Soc of Nav Archts & Marine Engrs, No. 7—Nov.,1902. No. 51-800 D.

Steamers.

High-Speed Channel Steamers. Information concerning the design of fast channel steamers, their weight, fittings, etc. 2200 w. Engr, Lond—Nov. 7, 1902. No. 51745 A.

Twin-Screw Steamship "Amur" (Doppelschhraubendampfer "Amur"). Illustrated description of a new steamer constructed for operation in connection with the terminus of the Eastern Railway of China. 2000 w. 2 plates. Zeitschr d Ver Deutscher Ing—Oct. 18, 1902. No. 51912 D.

The Twin-Screw Steamer "Hanoverian." An illustrated description of a typical ship of the combined cargo and passenger type. 1000 w. Engng—Oct. 31, 1902. No. 51620 A.

Stresses.

Longitudinal Bending Stress on Damaged Ships. George Crouse Cook. An investigation of this stress which is the most severe to which a vessel in normal circumstances is subjected. Gives illustrations of vessels when floating intact and with various compartments bilged. 21 plates. 7500 w. Trans Am Soc of Nav Archts & Marine Engrs, No. 6—Nov., 1902. No. 51799 D.

Submarines.

Submarine Torpedo-Boats—Past, Present and Future. Lawrence Spear. Historical review, with remarks on the outlook for the future. 7 plates. 10300 w. Trans Am Soc of Nav Archts & Marine Engrs, No. 14—Nov., 1902. No. 51806 D.

Submarine Work. Carlo Iberti. Concerning the inventions of Signor Pino, which it is claimed make possible the recovery of sunken ships or objects of any kind from practically any depth. Illustrated description of his working submarine boat. 2500 w. Contemporary Rev—Nov., 1902. No. 51704 D.

The Submarine Boat "Protector." Waldon Fawcett. Illustration with description of this submarine torpedo boat, recently launched. It is the invention of Mr. Simon Lake and is dissimilar to any other submarine boat. 1100 w. Sci Am—Nov. 22, 1902. No. 51776.

To Test Submarine Boats. Information concerning the extended trials the newly-constructed Holland craft is to undergo during the next two weeks. Ill. 1400 w. Naut Gaz—Nov. 13, 1902. No. 51759.

Tunnels.

The Strength of Tunnels for Propeller Shafts (Festigkeit von Wellentunneln). F. Kretzschmar. An anayltical examination of the stresses and strains in the shaft tunnels of screw steamers. Serial, Part I. Schiffbau—Oct. 23, 1902. No. 51963 D.

Vibrations.

The Vibrations of Steamships, With Special Reference to Those of Second and Higher Period. George W. Melville. A supplementary paper to one on the balancing of engines. Deals with the three questions—1st, Do important vibrations of second and higher periods occur? 2d, Are the unbalanced forces of higher period in the four crank engines important? 3d, Are the forces of higher period sufficient to account for the vibrations of corresponding period? 8 plates. 7000 w. Trans Am Soc of Nav Archts & Marine Engrs, No. 9—Nov., 1902. No. 51801 D.

Yachts.

Measurement Rules for Yachts, with Special Reference to Racing Conditions. F. W. Belknap. Discusses whether restriction by rule has hindered or developed the form of highest speed. 3000 w. Trans Am Soc of Nav Archts & Marine Engrs, No. 15—Nov., 1902. No. 51807 D.

Steam Yacht Wacouta. William A. Fairburn. A detailed description of the vessel and its equipment, with report of steam trials. 4700 w. Jour Am Soc of Nav Engrs—Nov., 1902. No. 51898 H.

Turbine Steam Yachts. Brief illustrated description of the turbine yacht Emerald, the largest pleasure yacht yet fitted with the Parsons' turbines. 800 w. Engr, Lond—Oct. 31, 1902. No. 51626 A.

MECHANICAL ENGINEERING

AUTOMOBILES.

Cylinder Cooling.

Non-Freezing Liquids for Cylinder Jackets. E. E. Keller. An account of investigations made by the writer. 1500 w. Auto Mag—Dec., 1902. No. 52016 C.

Cylinders.

The Explosive Wave in Engine Cylinders. Charles E. Lucke. An account of investigations of the causes of abnormally high pressures, which are often dangerous. Ill. 2000 w. Horseless Age—Nov. 19, 1902. No. 51783.

Designs.

Comparison of Certain 1902 Design Automobiles with Others Made in 1901 and 1902. George Otis Draper. The writer having used both steam and gasoline machines notes the relative troubles and gives conclusions. 1300 w. Horseless Age—Nov. 12, 1902. No. 51674.

Fly Wheels.

The Directional Tendency of the Inertia of the Flywheels and Vehicle Wheels. E. J. Stoddard. A study of rotation with an application to automobile running. 1200 w. Horseless Age—Nov. 26, 1902. No. 52022.

Gasoline Motors.

Some Details of Construction in Gasoline Motors. Hugh D. Meier. Discusses details of interest to designers of automobiles. 1300 w. Horseless Age—Nov. 12, 1902. No. 51675.

German Vehicle.

New German Automobile. Describes a new invention of Ludwig Maurer which applies the principle of friction in the transfer of power. 600 w. U S Cons Repts, No. 1496—Nov. 15, 1902. No. 51695 D.

Motor Cycles.

The Motor-Cycle Trade in Great Britain. Information concerning the popularity of these machines, the types in demand, desirable features, etc. Brief illustrated descriptions of popular machines. 2000 w. U S Cons Repts, No. 1504—Nov. 25, 1902. No. 51856 D.

Regulations.

Automobile Regulations in Europe. A synopsis of the laws governing automobile traffic in the various countries. 7800 w. U S Cons Repts, No. 1490—Nov. 8, 1902. No. 51528 D.

Searchlights.

Acetylene Searchlights for Automobiles. From *La Nature*. Considers some of the French searchlights. Ill. 1500 w. Sci Am—Nov. 15, 1902. No. 51692.

Speed Measuring.

The Auto-Chronograph. Illustrates and describes an apparatus devised by M. Maurice Espagnent for the precise measurement of speed. 1600 w. Auto Topics—Nov. 22, 1902. No. 51817 C.

Steam Truck.

Aultman 4-Wheel Drive Steam Truck for Commercial Use. Herbert L. Towle. Drawings and description of a heavy truck designed to carry a load of 5 tons. 1400 w. Auto & Motor Rev—Nov. 1, 1902. No. 51495.

Street Cleaning.

Automobiles for City Street Cleaning Departments Are Desired. A discussion of the requirements of the work with the aim of securing a self-propelled vehicle that will give satisfactory results. Ill. 2000 w. Auto & Motor Rev—Nov. 15, 1902. No. 51708.

We supply copies of these articles. See page 653.

Touring Car.

Ward Leonard Gasoline Touring Car Discussed Critically. Herbert L. Towle. This machine is illustrated and discussed in detail. 2300 w. Auto & Motor Rev—Nov. 22, 1902. No. 51790.

Voiturette.

The Milnes Voiturette. Illustrated detailed description of a new car attracting attention in England. 2200 w. Auto Jour—Oct. 25, 1902. No. 51476 A.

Winter Service.

Winter Use of Automobiles. A. L. Clough. States the technical difficulties of operating motor vehicles in cold weather, discussing each, and aiming to show that an all the year round usefulness is possible. 2200 w. Horseless Age—Nov. 19, 1902. No. 51782.

HYDRAULICS.

Electric Pumping.

See Electrical Engineering, Power Applications.

Flow.

The Flow of Water in Wood Pipes. Continued discussion of paper by Theron A. Noble. 4000 w. Pro Am Soc of Civ Engrs—Nov., 1902. No. 52013 E.

Governor.

A Water-Wheel Governor of Novel Construction. An illustrated description of the inertia governor of the centrifugal-ball type as used on the Replogle "Differential Relay" water-wheel governor, and the reversing frictional clutch. 1500 w. Eng News—Nov. 13, 1902. No. 51689.

Hydro-Electric Stations.

See Electrical Engineering, Generating Stations.

Plumbing.

Water Supply Systems in the Ansonia Apartment Hotel. Illustrated description of the supply for a very large 17-story steel and iron building in New York, with housekeeping and family hotel apartments for 1300 tenants. 3000 w. Eng Rec—Nov. 1, 1902. No. 51588.

Presses.

A New Principle in Hydraulic Presses. Illustrations and descriptions of applications of the principle invented by Otto Philipp, which saves the loss of power, and does away with the usual hydraulic plant of pumps, accumulator and piping. 1300 w. Am Mach—Nov. 13, 1902. No. 51678.

Pumping Engines.

See Civil Engineering, Water Supply.

Pumps.

Rotary Pumps. John T. Wilkin. Description is given of the construction and action of rotary pumps, particularly of a two lobe cycloidal pump, and its advantages shown. 2800 w. Trans Am Soc of Mech Engrs, No. 0970—Dec., 1902. No. 51873.

Sault Ste. Marie.

The Sault Ste. Marie Water Power Canal. Illustrations and brief description of one of the greatest hydraulic developments in the United States. 1000 w. Sci Am—Nov. 1, 1902. No. 51444.

Turbines.

The Jolly-McCormick Turbines at the "Soo." An illustrated description of these turbines with an outline of the history of this type. 1600 w. Ir Age—Nov. 20, 1902. No. 51764.

MACHINE WORKS AND FOUNDRIES.

Accident Prevention.

The Prevention of Accidents to Factory Workmen. Jacques Boyer. A review of French legislation and practice in guarding workmen from accidental injury from machinery. 4000 w. Engineering Magazine—Dec., 1902. No. 51997 B.

American Tools.

An English View of American Tools. William H. Booth. Considers the effects of American competition as regards machine tools upon English work. 3000 w. Am Mach—Nov. 6, 1902. No. 51551.

Boiler Shop.

The New Boiler Shop of the Alsace Machine Works (Die Neue Kesselschmiede der Elsässischen Maschinenbau-Gesellschaft zu Mülhausen i Elsass). With plans and sections of the buildings, showing arrangement of cranes, tools, etc. 2000 w. Zeitschr d Ver Deutschr Ing—Oct. 25, 1902. No. 51914 D.

Bolts.

The Stress on Bolts in Service. John H. Barr. Presents the results of some direct measurements of the initial load due to screwing up, and gives what is believed to be a rational treatment of the matter of the resultant load after the external load has been added. 2300 w. Sib Jour of Engng—Oct., 1902. No. 52017 C.

Brass.

Railroad Brass Founding—Driving Brasses. C. Vickers. Describes method of molding. Ill. 1300 w. Am. Mach—Nov. 27, 1902. No. 52026.

Case-Hardening.

A Job of Case-Hardening. E. R. Markham. Describes a method adopted to remedy troubles met in hardening small pieces. 1000 w. Am Mach—Oct. 30, 1902. No. 51436.

Casting Pit.

New Casting Pit at the "Angleur" Steel Works, Belgium. V. Firket. An illus-

trated description of the new pit in which the machinery is worked entirely by electricity. 1600 w. Ir & Coal Trds Rev—Nov. 14, 1902. No. 51886 A.

Castings.

Mixing Iron for Small to Medium Large Size Machinery Castings. P. Burke. Some suggestions from the writer's experience based on the percentage of combined carbon, free carbon and silicon. 1000 w. Foundry—Nov., 1902. No. 51530.

Vacuum Casting. A. E. Fay. Showing the main idea of vacuum casting to be erroneous, and indicating two legitimate uses of the idea. Reviews early inventions utilizing the vacuum idea, and the work of various inventors in order of time. 5400 w. Ir Age—Nov. 6, 1902. No. 51568.

Cost Keeping.

See Industrial Economy.

Cutting Tools.

The Action of Cutting Tools. William Taylor. From a paper read before the British Assn. Defines true cutting action and the action of shearing and of abrasives. 1000 w. Am Mach—Nov. 27, 1902. No. 52023.

Dies.

Combination Dies for an Aluminum Box. H. Robinson. Illustrations of the dies with description of the operation. 800 w. Am Mach—Oct. 30, 1902. No. 51438.

Punching Brass Clock Gears—Movable Stripping Devices. William Doran. Illustrations of punch and die, with descriptions of their use. 1000 w. Am Mach—Oct. 30, 1902. No. 51439.

Electric Cranes.

See Electrical Engineering, Power Applications.

Fans.

Theory of Centrifugal Blowers or Fans. R. C. Carpenter. Abstracted from new edition of Heating and Ventilating. The present article considers the theory of Daniel Murgue. 1800 w. Sib Jour of Engng—Nov., 1902. Serial, 1st part. No. 52020 C.

Forging.

Imperative Conditions for Forging Steel. From a paper by H. F. J. Porter, before the Engine B'ldr's Assn. Outlines the processes considered necessary in the manufacture of high grade forgings. 2000 w. Am Mfr—Nov. 13, 1902. No. 51707.

Formulas.

A Development of Machine Shop Formulas. Stanley H. Moore. Considers methods for finding the cost and proportions of machines built in a series of sizes. 2000 w. Mach, N Y—Nov., 1902. No. 51599 C.

Foundries.

Foundry Progress. Harris Tabor. Reviews the progress made in the casting of metals during the last 25 years. Ill. 1600 w. Am Mach—Nov. 6, 1902. No. 51555.

Foundry Management.

Foundry Management in the New Century. Robert Buchanan. The first of a series reviewing the best modern foundry practice in Europe and America. The present paper deals with the economical production of castings. 3500 w. Engineering Magazine—Dec., 1902. No. 51992 B.

Gear Cutting.

A Swedish Worm Spur and Spiral Gear Cutting Machine. An illustrated description of a machine for cutting spur and worm gear wheels, and its action. 600 w. Am Mach—Oct. 30, 1902. No. 51437.

Jigs.

Jigs for Molding Machines. S. H. Stupakoff. From a paper prepared for the Boston meeting of the A. F. A. Explains the use of a plate in connection with a suitable jig, especially prepared for the purpose, and the advantages. Ill. 2500 w. Foundry—Nov., 1902. No. 51532.

Lathes.

A Forty-Four-Foot Pit Lathe. John M. Barnay. Illustrated description of the construction of a heavy pit lathe for the manufacture of electrical machinery. 600 w. Trans Am Soc of Mech Engrs, No. 0968—Dec., 1902. No. 51875.

Railway Wheel Lathe. An illustrated description of an interesting machine recently brought out in England. 400 w. Engng—Nov. 7, 1902. No. 51742 A.

Locomotive Building.

The Progress of Locomotive Building in America. Editorial reviewing the figures prepared by the census authorities indicating the progress of this industry in the United States during the last ten years. 1000 w. Engng—Oct. 24, 1902. No. 51486 A.

Locomotive Works.

Enlargement of the Baldwin Locomotive Works. An illustrated description of the principal features of the extensive enlargement now under way. 3200 w. Ry Age—Nov. 21, 1902. No. 51834.

Improvements at the Baldwin Locomotive Works. An illustrated account of extensive improvements, mostly additions and remodeling of present equipment. 1500 w. R R Gaz—Oct. 31, 1902. No. 51459.

Machine Construction.

A Review of Progress in Machine Construction. Dr. Francis Reuleaux. Reviews the work of this paper during its life of twenty-five years. 1000 w. Am Mach—Nov. 6, 1902. No. 51556.

We supply copies of these articles. See page 653.

Manufacturing Plant.

The New Works of the B. F. Sturtevant Co., at Hyde Park, Massachusetts. W. B. Snow. Brief general description of the plant. 1500 w. Eng News—Oct. 30, 1902. No. 51449.

Metal Working.

Metal Working Machinery. Abstract of a United States Census report, prepared by Edward H. Sanborn upon the production of metal working machinery in the United States during the census year. 4300 w. Ir Age—Nov. 20, 1902. No. 51769.

Perforating Flat and Cylindrical Sheet Metal. Joseph V. Woodworth. An illustrated description of dies and fixtures used and methods of operating. 1600 w. Am Mach—Nov. 27, 1902. No. 52024.

Milling.

Milling Cutters. S. N. Brayshaw. Read before the Manchester (Eng.) Assn. of Engrs. On the making of cutters, their use and abuse, giving methods that the writer has found successful. Ill. 4800 w. Mech Engr—Nov. 1, 1902. No. 51612 A.

Milling Machine Feeds. P. V. Vernon. Describes a method of feed driving, which the writer considers efficient and practical. Also editorial note. 2000 w. Am Mach—Oct. 30, 1902. No. 51440.

Molding Machines.

The Relation of the Molding Machine to Foundry Labor. C. H. Mumford. Address before the New England Foundrymen's Assn. Discusses the relation of the molding machine to union foundry labor. 3800 w. Ir Age—Nov. 20, 1902. No. 51768.

Ping Pong Balls.

American Manufacture of Ping Pong Balls. Joseph Misko. An illustrated description of the method. 1200 w. Am Mach—Nov. 20, 1902. No. 51786.

Planer.

Spur Gear Planer. Illustrated description of a machine for planing large spur gears by the use of a single-pointed tool and templets. 500 w. Mach, N Y—Nov., 1902. No. 51600 C.

Quick Return.

"The Slow Advance and Quick Return Motion" as Produced by Means of Elliptical Wheels. Prof. C. W. MacCord. Discusses a method depending upon the varying angular velocity of one elliptical wheel, driven by another which revolves with uniform speed. Ill. 1800 w. Stevens Ind—Oct., 1902. No. 51547 D.

Rolling Mills.

The Treatment of Machinery in Rolling Mills. G. E. Flanagan. Discusses the bad treatment the machinery usually receives. 1400 w. Am Mach—Nov. 20, 1902. No. 51787.

Rugby Works.

The Rugby Works of the British Thompson-Houston Company. An illustrated detailed description of these works and their equipment. 4500 w. Elec Engr, Lond—Oct. 24, 1902. No. 51480 A.

Screw-Threads.

Finer Screw Threads. Charles T. Porter. Argues that the existing system reduces the area of cross-section of the bolt unnecessarily, and that the steep inclination allows the nut to jar loose easily. A table for the system proposed is given. 600 w. Trans Am Soc of Mech Engrs, No. 0964—Dec., 1902. No. 51879.

Shafting.

Shafting Out of Line. D. B. Dixon. Calls attention to the great waste of power due to imperfect shafting and imperfectly lined up shafting, and gives rules for determining the diameter needed to transmit a given horse power, and other rules for speed, etc. 2000 w. Am Mfr—Nov. 20, 1902. No. 51788.

Shrinkage.

An Automatic Foundry Test for Contraction. Asa W. Whitney. Suggests a test for contraction proposed as a rational chill test for cast iron. 2200 w. Ir Age—Nov. 13, 1902. No. 51671.

Springs.

Diagrams for Semi-Elliptic Plate Springs. Lawford H. Fry. Gives charts embodying the formulas used in the design of semi-elliptic plate springs such as are used on railroad rolling stock, with method of operation. 1700 w. Am Mach—Nov. 20, 1902. No. 51785.

Springs and Spring Making. C. A. Miller. Presented before the Nat. Ry. Mas. Blacksmiths' Assn. Considers points of importance in regard to the material and manufacture. 1600 w. Ry Mas Mech—Nov., 1902. No. 51524.

Standardization.

Analysis by Rote. Discussing the tendency of carrying mechanical standardization too far; or the danger of standardizing methods of testing, and of chemical analysis, as well as materials. 2000 w. Engr, Lond—Oct. 24, 1902. No. 51493 A.

Tools.

A Study of Lathe Tools (Note sur les Outils de Tours). A general review of the various forms of modern tools for use in the lathe with numerous illustrations, and a bibliography. 3500 w. Revue de Mécanique—Oct. 31, 1902. No. 51925 E+F.

Ventilation.

The Ventilation of Workshops. Reviews the first report of the Commissioners inquiring into the ventilation of factories

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and workshops. Deals only with general ventilation. 2200 w. Iron & Coal Trds Rev—Nov. 7, 1902. No. 51751 A.

Wages.

See Industrial Economy.

MATERIALS OF CONSTRUCTION.

Alloys.

Improved Method of Manufacturing Copper, Yellow Metal, and Naval Brass. H. J. Martin. Describes a new process which utilizes the heat contained in the charge for the purpose of rolling the metal in the "breaking down" and "drawing on" stages. 2500 w. Can Engr—Nov., 1902. No. 51636.

Typical Brassfounders' Alloys. John F. Buchanan. Discusses the causes that have led to the making of inferior metals, and recent innovations in the mixing of alloys. 2000 w. Foundry—Nov., 1902. No. 51533.

Diseases.

The Diseases of Iron and Copper (Krankheitserscheinungen in Eisen und Kupfer). E. Heyn. An examination of the changes in the constitution of metals which may be compared to the diseases of living beings. 3500 w. Stahl u Eisen—Nov. 15, 1902. No. 51954 D.

Microstructure.

The Microstructure of Iron and Steel. W. C. Post. Address before the Nat. R. R. Mas. Blacksmiths' Assn. Explains the manner of preparing the specimens and the methods of investigating. Ill. 2200 w. Ir Age—Nov. 20, 1902. No. 51767.

Oil Testing.

A New Oil Testing Machine and Some of Its Results. Albert Kingsbury. Illustrates and describes the apparatus and methods of testing, arranged with special reference to investigating the effects of either body or viscosity while excluding the effects of the other. 2500 w. Trans Am Soc of Mech Engrs, No. 0973—Dec., 1902. No. 51872 C.

Porcelains.

The Composition of Porcelains for Electrical Purposes. Abstract of a paper by Arthur S. Watts, in the *Transactions* of the American Ceramic Society. Gives results of exhaustive tests on electrical insulating porcelain. 3500 w. Elec Wld & Engr—Nov. 15, 1902. No. 51717.

Wire.

Experiments with Modern Steel Wire (Versuche mit Neuern Stahldrahtsorten). Julius Divis. An exhaustive examination of steel wire with respect to its use for mine hoisting cables. Serial. Part I. 2500 w. Oesterr Zeitschr f Berg u Hüttenwesen—Nov. 1, 1902. No. 51965 D.

MEASUREMENT.

Deflection.

The Deflection of Beams by Graphics. Willibald Trinks. An argument for the design of machinery on the basis of deflection permissible rather than strength, and for the use of graphical methods for determining the amount of deflection. 4800 w. Trans Am Soc of Mech Engrs, No. 0961—Dec., 1902. No. 51881 C.

Heat Insulation.

Heat Resistance, the Reciprocal of Heat Conductivity. William Kent. Advocates the use of figures representing resistance instead of conductivity, giving reasons for the change and suggestions for a standard to be adopted. 1800 w. Trans Am Soc of Mech Engrs, No. 0955—Dec., 1902. No. 51884.

Measurements.

A Rational Solution of the Problem of Weights and Measures. Sidney A. Reeve. A discussion of the advantages and disadvantages of the metric system and an advocacy of the advantages of a system which subdivides by halves, thirds, and quarters. 4800 w. Trans Am Soc of Mech Engrs, No. 0959—Dec., 1902. No. 51882 C.

Metric System.

The Metric System. F. A. Halsey. Discusses the actual use in countries where it has been adopted, showing the confusion of units to have been increased rather than diminished. 20,000 w. Trans Am Soc of Mech Engrs, No. 0956—Dec., 1902. No. 51883 D.

Surveying Instruments.

The Use of a Surveying Instrument in Machine Shop Practice. Charles C. Tyler. Describes its use for laying out work where the dimensions are so great as to demand the use of portable machine tools secured to a large floor surface plate, the tools being moved rather than the parts which are being machined. Ill. 4600 w. Trans Am Soc of Mech Engrs, No. 0969—Dec., 1902. No. 51874 C.

POWER AND TRANSMISSION.

Accounts.

Power Plant Accounts. Considers useful data that should be registered in the accounts of the engineer or superintendent of power plants. 3500 w. Engr, U S A—Nov. 1, 1902. No. 51516.

Cableways.

Aërial Cable Transportation. William Hewitt. An illustrated review of the various systems and the uses to which they have been applied. Also discussion. 8200 w. Pro Engrs Club of Phila—Oct., 1902. No. 51429 D.

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Compressed Air.

Air Appliances in the Wabash Shops. An illustrated description of modern appliances for utilizing compressed air. 2300 w. Ry Age—Nov. 7, 1902. No. 51637.

Compressed Air in English Mines. Sydney F. Walker. Discusses arrangements which result in losses, and the methods of overcoming them. 2200 w. Mines & Min—Nov., 1902. No. 51564 C.

Details of Vertical Air-Compressor (King-Riedler Type). An illustrated description. 1500 w. Plate. Engng—Nov. 14, 1902. No. 51870 A.

Escalator.

The Escalator. An illustrated description of a notable installation of moving stairways in Macy's new store in New York city. 900 w. Eng Rec—Nov. 8, 1902. No. 51665.

Gas Power.

See Gas Works Engineering.

Power Plants.

The Development of Power Plants. Fred R. Low. A review of improvements during the last quarter of a century, and the causes of the great advance in power-producing apparatus. 3500 w. Am Mach—Nov. 6, 1902. No. 51553.

The Power Plant. Charles H. Benjamin. The first of a series of papers considering the location, construction, equipment, arrangement, cost and operation of power plants. 3500 w. Engr, U S A—Nov. 15, 1902. Serial. 1st part. No. 51755.

Windmills.

Test and Analysis of a Windmill. Howard V. Meeks and George H. Sander. Graduation thesis. The test was to determine the h. p. developed for different velocities of wind and to see how these results compared with the theory as given by Rankine in formula 4, page 216, "Steam Engine." 1500 w. Stevens Ind—Oct., 1902. No. 51548 D.

SPECIAL MOTORS.

Entropy Analysis.

Entropy Analysis of the Otto Cycle. Sidney A. Reeve. Favors the construction of the entropy diagram for all engine tests. 2500 w. Trans Am Soc of Mech Engrs, No. 0962—Dec., 1902. No. 51880.

Gas Engines.

Engines for Blast Furnace Gas (Moteurs à Gaz de Haut-Fourneau). H. Hubert. A review of the development of large gas engines for use with blast furnace gases, with especial reference to the Delamare-Debouteville-Cockerill engines. 12,000 w. 2 plates. Rev Univ des Mines—Sept., 1902. No. 51930 H.

The Construction of Large Gas Engines (Verschiedeue Constructionen von Grossgasmotoren und ihr Verhalten im Betriebe). H. Reinhardt. Describing many large engines, with especial reference to the use of blast furnace gases. 10,000 w. 2 plates. Stahl u Eisen—Nov. 1, 1902. No. 51948 D.

Gasoline Engines.

The Different Grades of Gasoline Engines. Albert Stritmatter. Describes the features of the different grades, indicating the work for which they are adapted. 2300 w. Am Mfr—Oct. 30, 1902. No. 51468.

See also Mechanical Engineering, Automobiles.

Gas Power.

See Gas Works Engineering.

Oil Engine.

Test of a Priestman Safety Oil Engine. S. P. Howe, and C. Waterbury. Describes the engine and method of testing, giving results. Ill. 3200 w. Sib Jour of Engng—Oct., 1902. No. 52018 C.

STEAM ENGINEERING.

Air Pumps.

Some Notes on Air-Pump Design. C. L. Browne. Considers the important part borne by the condensing apparatus of a steam plant, and the weaknesses in the designs of condensers and air pumps. 1800 w. Elec Engr, Lond—Nov. 14, 1902. Serial. 1st part. No. 51853 A.

Balancing.

On the Balancing of Locomotive Engines. W. C. Kernot. Read before the Australasian Assn. for the Adv. of Science. An account of engines which had proved unsatisfactory because there were no balance weights, and the results after being properly balanced. A general discussion of the subject. 3200 w. Engng—Oct. 31, 1902. No. 51623 A.

Boiler Arrangement.

The Arrangement of Boilers for Screw Steamers (Anordnung der Betriebskessel für die Propellerbei Schiffen). A discussion of the Leux system of placing water-tube boilers in two tiers. Serial. Part I. 3000 w. Schiffbau—Nov. 8, 1902. No. 51964 D.

Boilers.

Navy Boiler Repairs. Editorial review of a report issued by the British Admiralty making a comparison between ships with shell boilers and those fitted with water-tube boilers. 1700 w. Engng—Nov. 14, 1902. No. 51869 A.

Specification for a Lancashire Boiler 30 ft. by 8 ft., for 200 lb. Working Pressure. Points out the main features to be kept in view and gives dimensions and details.

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1700 w. Prac Engr—Nov. 14, 1902. Serial. 1st part. No. 51850 A.

The Water-Tube Boiler in the American Mercantile Marine. William A. Fairburn. Briefly reviews the history of water tube boilers, and considers the features important in designing a boiler suitable for merchant vessels, the types in existence at present, the advantages, the operation, fuel, cost, etc. 19 plates. 26300 w. Trans Am Soc of Nav Archts & Marine Engrs, No. 5—Nov., 1902. No. 51798 D.

Economizers.

Economizers. H. F. Schmidt. Gives statements of advantages from the use of economizers. 1700 w. Am Elect'n—Nov., 1902. No. 51603.

Engines.

An Economical Mill Engine. Data and results of the feed water tests of a 16 and 40x48 inch Cooper-Corliss engine, and coal test of the plant connected therewith, as given in report of George H. Barrus, with information related. 2200 w. Eng Rec—Nov. 8, 1902. No. 51659.

Marine Engines on the Great Lakes from a Coast Engineer's Point of View. L. D. Lovekin. A comparison with coast practice, showing that the one great aim of the lake engines seems to be reduced cost. Covers the work done on an average freighter. 1600 w. Marine Engng—Nov., 1902. No. 51650 C.

Steam Engines at the Düsseldorf Exposition (Les Machines à Vapeur à l'Exposition de Düsseldorf). P. Dujardin. With illustrations of the more important engines, and a plate showing the large mine pumping engine by Haniel & Lueg. 2000 w. 1 plate. Génie Civil—Nov. 1, 1902. No. 51904 D.

Feed Water.

Difficulties in a Steel Mill Caused by Bad Feed Water. A. Osgyani. An account of troubles in a plant at Astoria, Long Island, and means taken to remedy. 1400 w. Ir Age—Nov. 6, 1902. No. 51567.

Flywheels.

Flywheel Capacity for Engine-Driven Alternators. Walter I. Slichter. Discusses the function of a flywheel and the causes which make the force on the crank-pin vary during a revolution. 3500 w. Trans Am Soc of Mech Engrs, No. 0967—Dec., 1902. No. 51876.

Fuel.

Coal Consumption. R. B. Starbuck. Read before the Toledo Div. of the Cent. Assn. of R. R. Officers. An account of success attained in burning soft coal without smoke according to the Sinclair system. 1000 w. St. Louis Ry Club—Oct. 10, 1902. No. 51526.

Heat Losses.

The Loss of Heat from Bare Steam Pipes. Charles P. Paulding. Showing that Péclet's theory of the loss of heat from a surface maintained at constant temperature gives results in agreement with practical tests of the loss of heat from bare steam pipes. 1200 w. Stevens Ind—Oct., 1902. No. 51548 D.

Indicators.

The Testing of Indicator Springs (Die Prüfung der Indikatorfedern). E. Roser. Giving descriptions of various methods of testing indicator spring both hot and cold, including the methods and appliances in the leading mechanical laboratories of Germany. 5000 w. Zeitschr d Ver Deutscher Ing—Oct. 18, 1902. No. 51913 D.

Liquid Fuel.

See Marine Engineering.

Pipe Joints.

Troubles with and Remedies for Leaky Pipe Joints. C. A. McAllister. Calls attention to conditions that must be fulfilled in designing flanges, and other things requiring attention to secure tight joints. Especially referring to marine work. 1800 w. Marine Engng—Nov., 1902. No. 51652 C.

Pressure.

The Safe Working Pressure of Steam Boilers. W. H. Wakeman. An explanation in full of rules for determining the safe working pressure. 2800 w. Engr, U S A—Nov. 1, 1902. No. 51517.

Pumping Engines.

See Civil Engineering, Water Supply.

Steam Heating.

Radiators and Heating. H. H. Kelley. Illustrates and describes many styles of cast iron radiators, with suggestions for determining the heating surface and other requirements. 2000 w. Engr, U S A—Nov. 1, 1902. No. 51515.

The Heating of Buildings with Very Low Pressure Steam (Le Chauffage des Batiments au Moyen de la Vapeur à Très Basse Pression). H. Heyninx. With details of the apparatus, showing the advantages of low over high pressure steam for heating. 3000 w. Revue Technique—Nov. 10, 1902. No. 51910 D.

Steam Plant.

Lighting and Heating Plant at Teachers' College, New York City. Illustrated description of a steam power plant for furnishing light and heat for six buildings. 2800 w. Engr, U S A—Nov. 15, 1902. No. 51754.

Modern Boiler-House Plant. F. J. Warden-Stevens. Discusses the considerations requiring care in the construction of steam-raising plants for large buildings.

We supply copies of these articles. See page 653.

2200 w. Archt, Lond—Nov. 7, 1902. No. 51724 A.

Power and Ventilation in the Bush Temple of Music, Chicago. Illustrated description of the mechanical steam plant, especially the arrangement for ventilating and heating the auditorium. 1700 w. Eng Rec—Nov. 8, 1902. No. 51664.

Steam Turbines.

The Brady Steam Turbine. An illustrated description of a new steam turbine which derives its motive power from the expansive force of steam, the same as does the reciprocating engine. Its advantages are stated, and tests reported. 1000 w. Ir Age—Oct. 30, 1902. No. 51441.

The Steam Turbine. Outlines the general principles of the leading types of steam turbines, paying more attention to their thermodynamic than to their constructive features. Ill. 2500 w. Mach, N Y—Nov., 1902. No. 51598 C.

Stoking.

An Improved Method of Economical Firing (Eine Neue Feuerungsweise zur Einschrankung des Kohlenmissbrauches). J. H. Mehrtens. A discussion of possible improvements in furnace construction, including the use of hollow grate bars to supply heated air. Serial. Part I. 3500 w. Glasers Annalen—Nov. 1, 1902. No. 51924 D.

Methodical Stoking for Large Installation of Water-Tube Boilers. Dagnino Attilio. Explains the necessity of uniform charging and means taken to secure good results, describing an apparatus for giving the signals automatically. Ill. 1800 w. Marine Engng—Nov., 1902. No. 51649 C.

Superheating.

Results of Tests of Compound Engine Using Superheated Steam (Einige Beschouwingen Over de Resultaten der Stoombeproeven met de Compound-Stoommachine, Werkende met Overhitten Stoom). H. A. Ravenek. Data and results of tests of the engines of the Tubantia Spinning Mills at Enschede. 8000 w. De Ingenieur—Oct. 18, 1902. No. 51959 D.

Steam Superheaters (Surchauffeurs de Vapeur). M. Loffet. With especial reference to the Maiche superheater, with data and results of tests. 2500 w. Revue Technique—Oct. 25, 1902. No. 51909 D.

Superheated Steam. H. L. Koenig. Considers methods of superheating, its use, applications of the system, etc. 2900 w. Sib Jour of Engng—Oct., 1902. No. 52019 C.

The Schmidt System of Superheating Steam (Die Erzeugung und Anwendung von Hochüberthitzten Dampf nach dem System von Wilhelm Schmidt). A discussion of the economy of high superheating, as obtained in the Schmidt apparatus. 2000 w. Oesterr Zeitschr f Berg u Hüttenwesen—Nov. 8, 1902. No. 51966 D.

Testing.

Trials of a Boiler and Pair of Compound Engines. Michael Longridge. States the object of the trials and gives results. 900 w. Mech Engr—Nov. 8, 1902. Serial. 1st part. No. 51731 A.

Thermodynamics.

Second Law of Thermo-Dynamics. Jacob T. Wainwright. An attack upon the law that of a given amount of heat at given temperature only a well defined portion can be converted into work. 2400 w. Ice & Refrig—Nov. 1, 1902. No. 51520 C.

Valve-Gears.

Graphical Chart for the Solution of Valve-Gear Problems. W. F. Durand. Describes a form of diagram or graphical representation of the relations involved, which, once drawn, shall contain the solution of all possible problems within the usual working range. 2500 w. Jour Am Soc of Nav Engrs—Nov., 1902. No. 51897 H.

Method of Laying Out and Adjusting Valves by Means of Valve Diagrams. Report of a lecture by Prof. C. A. Reed on the setting and design of engine valves. 2500 w. Engr, U S A—Nov. 15, 1902. No. 51756.

The Balancing of Valve Gears. A discussion of the force due to friction, the force due to gravity and the force due to inertia, advancing a method by which the crank shaft and valve gear bearings may be relieved of the inertia force in conjunction with the gravity effect. 8 plates. 5500 w. Trans Am Soc of Nav Archts of Marine Engrs, No. 16—Nov., 1902. No. 51808 D.

MISCELLANY.

Aeronautics.

De Bradsky Airship Disaster. Brief account with illustrations. 700 w. Sci Am—Nov. 15, 1902. No. 51694.

Recent Disasters in Aeronautics (Les Recentes Catastrophes en Aéronautique). G. Espitallier. A discussion of the Severo and de Bradsky accidents showing the necessity for triangular framing in the car suspension in dirigible balloons. 300 w. Génie Civil—Nov. 1, 1902. No. 51906 D.

Bicycles.

Dynamic Studies upon Bicycles (Recherches Dynamiques sur les Bicyclettes). Max Ringelmann. Showing the influence of the load, the tire, and the general condition of the machine upon its efficiency. 3000 w. Revue de Mécanique—Sept. 30, 1902. No. 51926 E+F.

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Centrifugal Machines.

Centrifugal Machines and Their Uses. Bartholomew Viola. Describes the various styles of centrifugal machinery in use for the separating and refining of sugars, cream, and the like. Ill. 3500 w. Trans Am Soc of Mech Engrs, No. 0000—Dec., 1902. No. 51871 C.

Discussions.

Topical Discussions and Notes of Experience. 3000 w. Trans Am Soc of Mech Engrs, No. 0954—Dec., 1902. No. 51885.

Filing System.

Filing System for Office Use. Henry M. Lane. Describes a system for filing and indexing clippings, etc. Ill. 1700 w. Trans Am. Soc of Mech Engrs, No. 0965—Dec., 1902. No. 51878.

Liquid Air.

Liquid Air. Editorial review of a lecture by Dr. Carl von Linde, on "The Technical Application of Liquid Air." Denies the possibility of using it for cold storage on a commercial scale. 2200 w. Engng—Nov. 7, 1902. No. 51743 A.

The Hampson Liquid Air Plant at McGill University, Montreal. Prof. John Cox. Briefly reviews the processes of various experimenters, and gives an illustrated description of the Hampson apparatus and its performance. 1300 w. Can Elec News—Nov., 1902. No. 51709.

Refrigeration.

Absorption Refrigerating Machines (Sulle Macchine Refrigeranti ad Assorbimento). R. Manzetti. A thermodynamic study of the absorption class of machines, using the temperature-entropy diagram. 7000 w. Ann d Soc Ing e Arch Ital—No. III, 1902. No. 51970 F.

Lake Superior Cold Stores. General illustrated description of the plant of the Lake Superior Produce & Cold Storage Co., at Houghton, Mich. 700 w. Ice & Refrig—Nov. 1, 1902. No. 51518 C.

The Refrigerating Plant of the Berlin Cold Storage Company (Die Berliner Kühlhäuser der Gesellschaft für Markt und Kühlhallen). Dr. C. Linde. With full details of the construction and machinery of this important cold storage plant in Berlin. 4000 w. Zeitschr d Ver Deutscher Ing—Nov. 1, 1902. No. 51916 D.

Ventilation of Cold Stores. Considers the factors that determine the need of systematic ventilation, the objections urged, and methods used. Ill. 3500 w. Ice & Refrig—Nov. 1, 1902. No. 51519 C.

Ventilation.

Ventilation in the Pratt Institute High School, Brooklyn, N. Y. Illustrates and describes the installation of improved facilities in an existing building without the necessity of much reconstruction. 1500 w. Eng Rec—Nov. 22, 1902. No. 51845.

MINING AND METALLURGY

COAL AND COKE.

Bins.

Cold-Storage Bins in the Pocahontas Field. An illustrated description of some of the early types, their shortcomings and later improvements. 2000 w. Mines & Min—Nov., 1902. No. 51557 C.

Briquettes.

The Briquetting of Fuels. R. Schorr. Considers this industry, its development in foreign countries, and what has been done in the United States. 1700 w. Eng & Min Jour—Nov. 8, 1902. No. 51658.

The Manufacture of Briquettes. Editorial review of the processes in use for briquetting fuel, the binding materials used, etc. 2200 w. Engng—Nov. 14, 1902. No. 51868 A.

British Columbia.

The Future of the Coal and Coke Supply of British Columbia. W. Blakemore. Showing that the prosperity of the province depends on an abundant supply of the best fuel at a low price, and discusses where to look for the coal needed. 3500 w. Can Min Rev—Oct. 31, 1902. No. 51505 B.

California Fuel.

Fuel Conditions in California. John L. Howard. Read before the Pacific Coast Gas Assn. Reviews the history of the coal deposits of California and their development, the imported coal, the use of gas as fuel, oil, etc. 3600 w. Jour of Elec—Nov., 1902. No. 51890 C.

Coal-Cutting.

Experiments with Coal-Cutting Machines in the Ruhr District. Bergassessor Kier, in *Glückauf*. An illustrated account of experiments made with American and German machines, describing the machines and reporting results. 3500 w. Col Guard—Oct. 31, 1902. No. 51616 A.

Three-Phase Electric Driving Applied to Coal-Cutting. Roslyn Holiday, in the *Journal of the British Soc. of Min. Students*. Gives reasons for adopting this system, and some of the experiences before

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success was assured. 1400 w. Col Guard —Oct. 31, 1902. No. 51618 A.

Coke.

Arsenic in Coke. A summary of recent researches, showing the occurrence to be general though in small quantities. 1300 w. Col. Guard—Nov. 7, 1902. No. 51739 A.

Coke. N. P. Hyndman. Read before the Pittsburg Foundrymen's Assn. Reviews its history since 1885, its mode of manufacture, quality, etc. 1700 w. Ir Age—Nov. 13, 1902. No. 51672.

See also Gas Works Engineering.

Colorado.

The Coal Fields of Routt County, Colorado. Describes a new field on the line of railroad being built between Denver and Salt Lake City, which will doubtless be greatly benefited by the construction of this road. Map. 2500 w. Eng & Min Jour—Nov. 1, 1902. No. 51580.

Lignite.

The Lignite Deposits of North Dakota. Frank A. Wilder. The first of three illustrated articles reviewing the nature and extent of these deposits, their fuel value, and present state of development. 2000 w. Eng & Min Jour—Nov. 22, 1902. Serial. 1st part. No. 51837.

Screening.

The Screening and Washing of Coal in the Dortmund District of Germany. Abstracted from a paper by Herr Jungeblodt in the *Zeitschrift für das Berg, Hutten und Salinenwesen.* The present article reviews the history of coal washing, tracing the improvements made since the beginning, 50 years ago. Ill. 2800 w. Ir & Coal Trds Rev—Nov. 7, 1902. Serial. 1st part. No. 51753 A.

Stripping.

Coal Stripping by Steam Shovel in Kansas. W. R. Crane. An illustrated description of the methods employed, the cost of the stripping operations ranging from 2½ to 3 cents per cubic yard. 3300 w. Eng & Min Jour—Nov. 8, 1902. No. 51655.

Supply.

Our Fuel Supply. Abstract of a paper read by James Anderson before the Inst. of Marine Engrs. Considers the increasing demands; the enhanced value; the necessity of conserving; the substitutes for coal, etc. 1900 w. Col Guard—Nov. 7, 1902. No. 51740 A.

COPPER.

Assaying.

The Assay of Copper Bullion. Thomas B. Swift. Gives details of a method for the determination of gold-silver in copper bullion. The essential point is the preliminary amalgamation of the copper to be assayed. 1200 w. Eng & Min Jour —Nov. 15, 1902. No. 51699.

Blast Furnaces.

Some Notes on High Blast Furnace Duties. Herbert Lang. Comments on the work done in copper smelting by Messrs. Heywood and Johnson. 3300 w. Eng & Min Jour—Nov. 8, 1902. No. 51656.

British Columbia.

The Granby Mines of Phœnix, B. C. C. M. Campbell. An illustrated article describing the development and methods employed. The ores are copper, gold and silver; the chief values being in the copper pyrites. 3600 w. B C Min Rec—Nov., 1902. Serial. 1st part. No. 51677 B.

Concentration.

Development of Coarse Concentration in the Slocan District, B. C. Samuel S. Fowler. Considers the silver-lead mining industry of the Slocan, discussing what has been done toward working the deposits economically, giving brief description of the methods. 5000 w. Can Min Rev—Oct. 31, 1902. No. 51506 B.

Lake Superior.

Lake Superior Copper. Horace J. Stevens. Gives facts in regard to the condition of the market and the development of some of the principal mines. 1400 w. Mines & Min—Nov., 1902. No. 51561 C.

New Mexico.

The Copper Belt of the Burro Mountains, Grant County, New Mexico. D. Bauman. Brief illustrated description. 500 w. Min Rept. Nov. 20, 1902. No. 51831.

New South Wales.

Copper in New South Wales. Information concerning the mining since 1845. 800 w. U S Cons Repts, No. 1495—Nov. 14, 1902. No. 51681 D.

Ontario.

Copper-Nickel Mining in Ontario. Abstract of a review by T. W. Gibson of the nickel and copper mining industries. 3000 w. Can Min Rev—Oct. 31, 1902. No. 51507 B.

GOLD AND SILVER.

Alluvial Mining.

Hydraulic Sluicing and Alluvial Mining in New Zealand in 1901. A review of the annual reports of the Inspectors of Mines for the Otago goldfields, New Zealand. Ill. 14000 w. N Z Mines Rec—Sept. 16, 1902. No. 51477 B.

Assaying.

Methods of Assaying Cyanide Solutions for Gold. T. Lane Carter. A compila-

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tion of methods for determining the gold contents of working cyanide solutions. 800 w. Eng & Min Jour—Nov. 15, 1902. No. 51698.

Cyaniding.

Details of Cyaniding. Ernst Gayford. An account of the process of milling used by the Horseshoe G. M. Co., Nevada. 2000 w. Min & Sci Pr—Oct. 25, 1902. No. 51498.

Dredging.

Dredging for Gold. Enos Brown. Illustrates and describes the work as carried on at Oroville, Butte Co., Cal., giving a brief review of earlier work, and explaining the difficulties. 1400 w. Sci Am—Nov. 8, 1902. No. 51596.

Placer Mining.

Placer Mining in Josephine County, Oregon. A. B. Cousins. Describes the conditions and gives an account of what has been done since the discovery of gold in 1851 in this district. Ill. 1000 w. Eng & Min Jour—Nov. 1, 1902. No. 51581.

Sampling.

Difficulties and Errors in Sampling Ores of Gold and Other Metals. P. G. Morgan. An account of some sampling from the writer's experience, calling attention to a few sources of error, and suggestions. 1000 w. N Z Mines Rec—Oct. 16, 1902. No. 51851 B.

Smelting.

New Smelting Plant at El Paso, Texas. C. W. Arthur. An illustrated description of what is said to be one of the largest and best equipped smelters in the world. 1400 w. Min & Sci Pr—Nov. 15, 1902. No. 51887.

New El Paso, Texas, Oil-Burning Blast-Furnace Plant. C. W. Clapp. Illustrated description of a new plant, interesting because of its labor-saving devices and its successful use of oil as a power developer. 1500 w. Sci Am Sup—Nov. 22, 1902. No. 51777.

Ore Dressing and Smelting at Santa Fe, Mexico. Henry F. Collins. Abstract of a paper presented before the Inst. of Min. & Met. Describes the system of concentration practiced, the smelting, etc. 3300 w. Eng & Min Jour—Nov. 15, 1902. No. 51697.

Smelting on Vancouver Island, B. C. Illustrated description of the smelter built at Crofton, and its operation. 1600 w. Min & Sci Pr—Nov. 8, 1902. No. 51758.

Sulphides.

The Thermo Hyperphoric Process. A. S. Firth. A brief account of this process for the treatment of heavy complex sulphide ores containing large quantities of galena and zinc blend, iron and copper, sulphides, and more or less gold, antimony, and manganese oxide with traces of tellurium and free sulphur. 500 w. Jour of Chem & Met Soc of S Africa—Sept., 1902. No. 51727 E.

Treatment of Complex Sulphides. Paper read before the Inst of Min. & Met. (London). A description of the Sulman-Picard process for treating complex sulphide ores. 2300 w. Aust Min Stand—Sept. 25, 1902. Serial. 1st part. No. 51613 B.

Valuation.

Notes on Valuing a Gold Mine. T. Lane Carter. Considers some of the principal points in valuing a gold mine. 5400 w. Jour of Chem & Met Soc of S Africa—Sept., 1902. No. 51728 E.

Witwatersrand.

An Estimate of the Gold Production and Life of the Main Reef Series, Witwatersrand. Thomas Haight Leggett and Frederick H. Hatch. Abstract of a paper read before the Inst. of Min. & Met., London. A collection of facts upon which estimates may be based, with tabulated results. 2000 w. Eng & Min Jour—Nov. 1, 1902. No. 51578.

IRON AND STEEL.

Blast Furnace.

A Modern French Blast Furnace. Illustrated description of a plant at Cette, on the Mediterranean. 1500 w. Ir Age—Nov. 6, 1902. No. 51569.

The Meehan Furnace Devices. Diagrams and descriptions of the furnace top down comer and explosion pipe. 1300 w. Am Mfr—Nov. 13, 1902. No. 51706.

Electric Driving.

See Electrical Engineering, Power Applications.

Electric Furnace.

The Electric Smelting of Iron Ore. A. J. Rossi. A statement of what the writer thinks could legitimately be expected from the electric smelting of pig iron in the present state of the arts. 6500 w. Ir Age—Nov. 20, 1902. No. 51766.

Furnace.

The Oldest Iron Furnace West of the Allegheny Mountains. Brief account, with illustration, of the "Alliance Furnace," built in 1789. 700 w. Eng News—Nov. 20, 1902. No. 51818.

Iron-Works.

Carron and Other Falkirk Iron Works Past and Present. Reviews the history and present condition of these works. 2000 w. Engr, Lond—Nov. 7, 1902. No. 51747 A.

Molybdenum.

The Rapid Determination of Molybdenum in Steel. George Auchy. A brief

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description of the method as now used. 600 w. Ir Age—Nov. 20, 1902. No. 51765.

Pig Iron.

Germany's Progress in the Manufacture of Pig Iron Since 1880. Facts taken from a paper by W. Bruegmann, presented at the Düsseldorf meeting of the British Iron & Steel Inst. 3500 w. Ir Age—Nov. 13, 1902. No. 51670.

Manufacture of Pig Iron. Charles Fox. Read before the Can. Assn. of Sta. Engrs. Considers the classifications according to the purpose to which the pig is applied, the constituents, etc. 1500 w. Foundry—Nov., 1902. No. 51531.

Segregation.

Effect of Segregation on the Strength of Steel Rails. Thomas Andrews. Abstract of a paper read before the Soc. of Engrs. Investigations showing the extent of segregation of combined carbon and other elements, the effect, giving typical examples. 5000 w. Ir & Coal Trds Rev—Nov. 7, 1902. No. 51750 A.

MINING.

Accidents.

First Aid to Injured in Mining Accidents. Dr. George W. King. A paper read at Butte meeting of the International Min. Cong. Illustrates and describes methods of treatment and devices to prevent further injury in handling wounded persons. 4500 w. Mines & Min—Nov., 1902. No. 51559 C.

Breaking Ground.

Notes on Breaking Ground. T. Lane Carter. Discusses questions of importance in breaking ground economically, and methods of working. 2000 w. Eng & Min Jour—Nov. 1, 1902. No. 51579.

Briquetting.

The Briquetting of Minerals. Robert Schorr. On the value of briquetting in connection with metallurgical processes and the manufacture of artificial stone, and the processes in use. 1200 w. Eng & Min Jour—Nov. 22, 1902 No. 51836.

Electric Hoist.

See Electrical Engineering, Power Applications.

Electric Power.

See Electrical Engineering, Power Applications.

Electric Pumping.

See Electrical Engineering, Power Applications.

Explosives.

Hathamite. Waldon Fawcett. Information concerning a new powerful explosive which may be handled with impunity, under ordinary conditions. Ill. 600 w. Sci Am—Nov. 8, 1902. No. 51595.

Fans.

Modern Fans. Charles H. Innes. An illustrated article discussing the design of fans with the object of utilizing as much of the energy as possible, the unavoidable losses, etc. Describes the Rateau fan, and the Heenan and Gilbert fan in this article. 2000 w. Engng—Nov. 14, 1902. Serial. 1st part. No. 51865 A.

On the Erection and a Few Tests of a Turbo-Fan and Generator at Hulton Colliery. Alfred J. Tongue. Read before the Manchester (Eng.) Geol. Soc. States the conditions of the ventilation and the position of the shafts prior to the erection of the turbo fan, giving an illustrated description of the plant and testing. Also discussion. 3800 w. Ir & Coal Trds Rev—Oct. 31, 1902. No. 51631 A.

Firedamp.

Electrical Tester for Firedamp. G. Leon, in *Annales des Mines.* Illustrated description of the apparatus with statement of the advantages claimed. 1000 w. Col Guard. Nov. 14, 1902. No. 51861 A.

Haulage.

The Tail-Rope Haulage System in a Coal Mine. An illustrated account of this system, with information concerning cost of equipment and maintenance. 2000 w. Eng & Min Jour—Nov. 22, 1902. No. 51840.

Mechanical Engineers.

The Mechanical Engineer a Factor in Modern Mining, Milling and Smelting. C. H. Repath. Read at Butte meeting of International Min. Cong. Calls attention to illustrations shown at copper mining and reduction works, Butte, Mon. 6800 w. Mines & Min—Nov., 1902. No. 51563 C.

Ore Deposits.

Ores Which Are Deposited by Underground Waters. J. M. Maclaren. Reviews the history of the work done by these waters. 2000 w. Min & Sci Pr—Nov. 15, 1902. No. 51888.

Prospecting.

Sizing Up a Prospect. Arthur Lakes. Some of the points to be considered in determining the value when only a small amount of work has been done. Ill. 2000 w. Mines & Min—Nov, 1902. No. 51558 C.

Pumps.

Suspended Pumps in Deep Shafts. W. Price Abell. Read before the Inst. of Waterworks Engrs. An illustrated outline of modern practice of using slung pumps for sinking purposes. 1800 w. Col Guard—Oct. 31, 1902. No. 51617 A.

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Quarrying.

Pumping Arrangements at the Penrhyn Quarries. Illustrations and explanations showing the conditions under which pumping has to be carried on, and how it is done. 1200 w. Quarry—Nov. 1, 1902. No. 51669 A.

The Quarrying Industry in Havana. C. E. McDowell. Information relating to the quarries in the vicinity of Havana. 2700 w. Stone—Aug., 1902. No. 51789 C.

Safety Appliances.

Safety Pit Cages. Are They Desirable. An inquiry aroused by the accident at Tirpentwys Colliery as to a remedy for accidents due to rope breakage. 1400 w. Ir & Coal Trds Rev—Oct. 24, 1902. No. 51487 A.

Shaft Sinking.

New Methods of Deep Boring. Illustrated discussion of devices invented by J. Howarth, and W. Pruszkowski, and W. Wolski. 2600 w. Aust Min Stand—Oct. 23, 1902. No. 52143 B.

Shaft-Sinking at the Rheinpreussen Colliery with the Pattberg Drill. L. Hoffman, in *Glückauf*. Illustrates and describes the sinking of two new shafts to depths of 140 and 165 metres respectively. The important feature is the percussive action of the drilling tools being effected by means of a swinging drum, and the continuous removal of the debris. 1600 w. Col Guard—Nov. 14, 1902. No. 51860 A.

Timbering.

Timbering in German Collieries. From the report of the Prussian Committee on Falls of Roof and Coal in Mines. Illustrates the manner of timbering, discussing the causes of falls, methods of working, etc. 1700 w. Col Guard—Oct. 24, 1902. Serial. 1st part. No. 51482 A.

Valuation.

Mine Valuation by Mining Experts. Editorial discussing a paper by Dr. Rossiter W. Raymond, read before the Am. Inst. of Min. Engrs. 2000 w. Eng News—Oct. 30, 1902. No. 51452.

"Ore in Sight." A. W. Warwick. Discussion of the rulings of the committee of the Inst. of Min. & Met., London. 2000 w. Min Rept—Nov. 20, 1902. Serial. 1st part. No. 51830.

Winding Engine.

Conical-Drum Winding Engine. An illustrated description of a large vertical cross-compound winding engine exhibited at Düsseldorf. 1300 w. Engng—Nov. 7, 1902. No. 51741 A.

MISCELLANY.

Asbestos.

Asbestos. A. Leonard Summers. Considers the sources of supply methods of mining, and processes used in manufacturing. 1800 w. Mines & Min—Nov., 1902. No. 51562 C.

China.

Mineral Wealth of China. F. R. Wardle. A study in detail of the mineral resources of each province. 1800 w. Min & Sci Pr—Oct. 25, 1902. Serial. 1st part. No. 51499.

Diamonds.

Brazilian Diamonds and Carbons. An account of the discovery. Geological formation, methods of mining, etc. 1700 w. Jour Soc of Arts—Nov. 14, 1902. No. 51846 A.

Lead.

Volumetric Determination of Lead. W. W. Dods. A commentary on H. H. Alexander's method of standardizing in the volumetric determination of lead by ammonium urolybdate solution. 2000 w. Aust Min Stand—Oct. 30, 1902. No. 52144 B.

Opals.

The Opal-Mining Industry and the Distribution of Opal Deposits in Queensland. C. F. V. Jackson. An illustrated article reviewing the history of the development of opal mining, the geology, extent of prospecting, mode of occurrence, varieties, quality, etc., with the progress of the industry. 6500 w. Queensland Gov Min Jour—Oct. 15, 1902. Serial. 1st part. No. 52171 B.

Petroleum.

Impurities in Crude Petroleum of Low Gravity. P. W. Tompkins. Read before the Pacific Coast Gas Assn. Considers methods for the rapid determination of the foreign matter contained in petroleum: 3700 w. Jour of Elec—Nov., 1902. No. 51892 C.

The Texas-Louisiana Oil Field. Information from a report by Dr. C. W. Hayes and Mr. William Kennedy. 1400 w. Sci Am Sup—Nov. 15, 1902. No. 51701.

Phosphate.

Phosphate Rock in New Zealand. James Park. A description of the deposits recently discovered and the geology of the district. 2800 w. Aust Min Stand—Sept. 11, 1902. Serial. 1st part. No. 51478 B.

Tasmania.

Mining in Eastern Tasmania. Begins a discussion of the mining industry and the methods of prospecting and mining which have proved so disastrous. 2000 w. Aust Min Stand—Oct. 30, 1902. Serial. 1st part. No. 52145 B.

Tin.

Tin-History and Production. Charles Stevens. Reviews the history of this mineral, giving the sources of supply, the formation of the lodes, etc. 2700 w. Aust Min Stand—Oct. 16, 1902. Serial. 1st part. No. 51848 B.

We supply copies of these articles. See page 653.

RAILWAY ENGINEERING

CONDUCTING TRANSPORTATION.

Accidents.

Railroad Accidents—Year Ending June 30, 1902. Main portions of the fourth quarterly bulletin of the Interstate Commerce Commission. Also editorial. 3500 w. R R Gaz—Oct. 31, 1902. No. 51461.

Train Accidents in the United States in September. Condensed record of the principal train accidents during the month, with comments. 2500 w. R R Gaz—Nov. 7, 1902. No. 51591.

Collisions.

The Superintendent, the Conductor, and the Engineman. A summary of the essential points presented in letters criticizing an article by this title which appeared in the issue of July 8. 5000 w. R R Gaz—Nov. 14, 1902. No. 51682.

Safety Appliances.

The Development of Safety Appliances on the Prussian-Hessian State Railways (Einrichtungen zur Erhöhung der Betriebsicherheit auf den Preussian-Hessischen Staatsbahnen). H. Scholkmann. With especial reference to the introduction of the block system and improved methods of signaling. 5000 w. Glasers Annalen—Nov. 15, 1902. No. 51956 D.

FINANCIAL.

Wages.

Increasing the Wages of Railway Employes. Editorial discussing the 10 per cent. increase ordered by the Pennsylvania Co., and facts showing why the action cannot be generally followed. Also the general notice to the employes of the Wabash R. R. Co. 1700 w. Ry Age—Nov. 21, 1902. No. 51833.

MOTIVE POWER AND EQUIPMENT.

Cars.

Fifteen and Twenty-Ton Wooden Coal Wagons—North Eastern Railway. Brief description with illustrations. 500 w. Ir & Coal Trds Rev—Nov. 7, 1902. No. 51752 A.

Medical Relief Car of the Prussian State Railway (Die Herstellung der Arztwagen für die Hülfszüge der Preusischen Staatseisenbahn-Verwaltung). H. Schlesinger. With general description of the hospital car and plates of details. 1800 w. 2 plates. Glasers Annalen—Nov. 15, 1902. No. 51957 D.

Special Cars for the Transport of Living Fish (Les Wagons Spéciaux Affectés au Transport des Poissons Vivants). M. Goeury. Describing a special form of tank car used in central Europe and Russia. 3000 w. 1 plate. Rev Gen des Chem de Fer—Nov., 1902. No. 51928 H.

The Extent of Damage Done to Freight Cars While Switching in Terminal Yards and on Sidings. General discussion of this subject. 7000 w. Pro W Ry Club—Oct. 21, 1902. No. 51667 C.

Two-Floor Sheep or Cattle Wagon. Illustrated description of a car used on Argentine railways. The upper floor is raised when it is used for cattle, and lowered into position when the two floors are required for sheep. 600 w. Engr, Lond—Oct. 24, 1902. No. 51494 A.

Vanderbilt Structural Steel Car. Illustrated description of hopper bottom self-dumping coal cars being placed in service on the W. Va. Cent. & Pittsburg. 500 w. Ry Age—Nov. 14, 1902. No. 51761.

Couplers.

Side Play Required in Car Couplers. Theodore H. Curtis. Gives formulas for computing the end sill clearance on curves, and length of safety chains. 1100 w. Am Engr & R. R. Jour—Nov., 1902. No. 51511 C.

Fire Protection.

The Fire Protection of Railway Trains (Feuerschutzmittel für Eisenbahn fahrzeuge). H. Schumacher. Giving the results of experiments upon the fire-proofing of the materials of construction used for railway cars. 2000 w. Glasers Annalen—Nov. 15, 1902. No. 51958 D.

Liquid Fuel.

Oil as Locomotive Fuel. Abstracts from a comparison of oil and coal as locomotive fuel from an economical standpoint, as given in a pamphlet issued by the Baldwin Locomotive Works. Ill. 4000 w. Ry Mas Mech—Nov., 1902. No. 51523.

Oil Fuel for Locomotives. Information from a pamphlet issued by the Baldwin Locomotive Works, discussing at length the subject of oil fuel for locomotives. 3300 w. R R Gaz—Oct. 31, 1902. No. 51462.

Locomotives.

Compound Engine—Norwegian State Railways. Illustration, with description of an engine designed to have a great traction effort and yet run smoothly and steadily in traversing curves while hauling pasenger trains. 1500 w. Engr, Lond—Oct. 24, 1902. No. 51491 A.

El Paso—Rock Island Locomotives. Engraving, line drawings and brief de-

We supply copies of these articles. See page 653.

scription of an engine of the Prairie type. 400 w. Ry Age—Oct. 31, 1902. No. 51500.

New Passenger Locomotives for the Vandalia Line. Illustrated description of recently built engines of the Atlantic type. 1400 w. Ry & Engng Rev—Nov. 1, 1902. No. 51521.

New Passenger Power for the Jersey Central. Illustrated description of recent engines of the Atlantic type furnished for fast passenger service. 300 w. Ry Age—Nov. 14, 1902. No. 51760.

New Six-Coupled Freight Locomotives. Describes the 2-6-2 type on the C. B. & Q. Ry. Ill. 400 w. Am Engr & R R Jour—Nov., 1902. No. 51510 C.

Tank Engines for Norway. Illustration and longitudinal section of two very powerful locomotives constructed for the Dunderland Iron Ore Co., Norway. The specifications are given. 1800 w. Engr, Lond—Oct. 31, 1902. No. 51625 A.

Two-Cylinder Compound Switching Locomotive. Illustrated description of an engine designed for heavy yard work for the N. Y., N. H. & H. R. R. 350 w. Am Engr & R R Jour—Nov., 1902. No. 51508 C.

Lubrication.

Automatic Grease Lubricator. Illustrated description of a new device in use on the D. L. & W. R. R. for lubricating locomotive driving and truck journals. 1200 w. Am Engr & R R Jour—Nov., 1902. No. 51513 C.

Superheating.

Locomotives Using Superheated Steam. G. Lentz. States the advantages of superheated steam, and the points of importance in their arrangement, illustrating and describing the Schmidt superheater. Also short editorial. 3000 w. Am Engr & R R Jour—Nov., 1902. No. 51509 C.

Tubes.

Long Tubes Do Not Vibrate. Description of an experiment made on a fast passenger engine on the L. S. & M. S. Ry. 600 w. Loc Engng—Nov., 1902. No. 51503.

NEW PROJECTS.

New Trunk Line.

Kansas City, Mexico & Orient Railway. Albert Phenis. An illustrated account of Arthur E. Stilwell's project connecting the southwest and Mexico's Pacific coast, what has already been accomplished, and the advantages of the route. 2200 w. Mfrs Rec—Nov. 13, 1902. No. 51702.

Peru.

Railway Projects in Peru. An account of a proposed railway by American capitalists to connect the two oceans, crossing the Andes at their lowest point, and reaching navigable waters emptying into the Amazon. 900 w. U S Cons Repts, No. 1499—Nov. 19, 1902. No. 51725 D.

TRAFFIC.

Freight.

Railway Freight Claims. R. L. Calkins. A discussion of the freight claim department, its purposes and relations to other departments. General discussion follows. 11000 w. N Y R R Club—Oct. 16, 1902. No. 51668.

Light Railways.

The Limits to the Capacity of Light Railways (Ueber die Grenzen der Leistungs fähigkeit der Kleinbahnen). A. Liebmann. A comparison of the capacity of various light interurban railways in Germany, deducing their probable commercial limitations. 3000 w. Ill. Zeitschr f Klein u Strassenbahnen—Nov. 1, 1902. No. 51973 D.

Tonnage Rating.

What Tonnage Rating Really Is. An explanation or draw bar pull, and how it differs from train weights, with description of J. M. Daly's locomotive rating cabinet. 1200 w. Loc Engng—Nov., 1902. No. 51501.

PERMANENT WAY AND BUILDINGS.

Convention.

Convention of the Bridges and Building Association. An account of meeting, with reports, discussions, etc. 7500 w. R R Gaz—Oct. 31, 1902. No. 51460.

Cut-Off.

Ogden and Lucin Railway Cut-Off. Don Maguire. An account of the inception of this work and a short descriptive sketch of the cut-off construction, with illustrations. 2500 w. Min & Sci Pr—Nov. 8, 1902. No. 51757.

Grades.

Virtual Grades for Freight Trains. A. C. Dennis. An account of experimental investigations to see what minor grades could be run with momentum, and where the stalling point was on those which could not be run. 2000 w. Pro Am Soc of Civ Engrs—Nov., 1902. No. 52011 E.

Improvements.

Improvements on the Lackawanna Since 1899. An illustrated review of changes made in equipment and permanent way. 5000 w. R R Gaz—Nov. 14, 1902. No. 51683.

Improvements on the New York Central. Notes from the annual report of the company concerning important improvements under way or contemplated. 800 w. R R Gaz—Oct. 31, 1902. No. 51463.

We supply copies of these articles. See page 653.

Improvements on the Pennsylvania R R at Duncannon, Pa. Brief illustrated description of a change of alignment which gives an unobstructed view of the track and eliminates 16 grade-crossings. 500 w. Ry & Engng Rev—Nov. 8, 1902. No. 51638.

South-Eastern and Chatham Improvements. An illustrated account of widenings, loops, reconstructed stations, and other improvements. 3500 w. Transport —Oct. 24, 1902. No. 51475 A.

India.

The Railway Station at Bombay, India. Tipton S. Blish. Illustration and information concerning the most beautiful railway station in the world. 1200 w. St Louis Ry Club—Oct. 10, 1902. No. 51525.

Interlocking.

Interlocking at Maumee River Bridge, Toledo. Illustrates and describes an interesting recently completed plant on the L. S. & M. S. Ry. 1400 w. R R Gaz—Nov. 21, 1902. No. 51829.

Reports.

Abstracts of Reports at the Convention of the Association of Railway Superintendents of Bridges and Buildings. Reports on auxiliary coaling stations, wearing surface of roadway for overhead bridges and turntables operated by power. 2500 w. Eng News—Oct. 30, 1902. No. 51450.

Shops.

Improvements at the Chicago and North Western Shops. Illustrated detailed description of improvements in engine terminal facilities and other departments. 2000 w. R R Gaz—Nov. 21, 1902. No. 51827.

The New Shops of the Atchison, Topeka & Santa Fe. An illustrated detailed description of these large shops and their equipment, with inset. 3800 w. R R Gaz —Nov. 7, 1902. No. 51589.

The Railway Workshops at Addington, New Zealand. Illustrations and account of work at these shops which manufacture all articles used in connection with the railways. St Louis Ry Club—Oct. 10, 1902. No. 51527.

Signals.

Electric Distance Signals (Die Einrichtung des Elektrischen Distanzsignales). A. Prasch. An account of the improved Krizik system as used on an experimental section of the Austria State Railways. 4000 w. Zeitschr d Oesterr Ing u Arch Ver—Oct. 31, 1902. No. 51920 B.

Good Practice in the Use of Distant Signals. W. H. Elliott. Read before the Ry. Sig. Club at Pittsburg. Gives experience of different roads with distant signals, and discusses causes that affect the operation of signals. 3000 w. R R Gaz —Nov. 7, 1902. No. 51590.

Station.

Passenger Station for the Wabash R. R. at Pittsburg. Illustrations with brief description. 600 w. Ry & Engng Rev—Nov. 1, 1902. No. 51522.

Track Elevation.

Allegheny Track Elevation. H. S. Wilgus. A descriptive account of the work, method of construction, cost, materials, etc. 2700 w. Pro Engrs Soc of W Penn—Oct., 1902. No. 51781 D.

Train Shed.

The Erection of the Pennsylvania R. R. Train Shed, Pittsburg. Describes the erection of a 260 x 555 foot building 110 ft. in extreme height, in which the difficulties of erection were increased by the necessity of maintaining uninterrupted service, and many complications due to raising the grades and constructing on the site of the old building. 2500 w. Eng Rec—Nov. 1, 1902. No. 51586.

Turntables.

Electrically Operated Turntables. Extract from a committee report to the Assn. of Ry. Supts. of Bridges and Bldgs. Ill. 2500 w. Am Engr & R R Jour—Nov., 1902. No. 51512 C.

MISCELLANY.

Management.

Railroad Management in England and the United States. Charles Hansel. An explanation of the different conditions in the two countries which make the methods incomparable. 1200 w. R R Gaz—Nov. 21, 1902. No. 51828.

Manufacturing.

Railway Companies as Manufacturers. Editorial discussing the English practice, the railway companies making everything they use. Does not consider the practice necessarily economical. 1000 w. Loc Engng—Nov., 1902. No. 51502 C.

M. C. B. Convention.

A Review of the Master Car Builders' Convention of 1902. J. W. Taylor. Outlines the work done at the last convention. General discussion follows. 12000 w. Pro W Ry Club—Oct. 21, 1902. No. 51666 C.

Records.

A Method of Preparing and Preserving Records of Railway Real Estate. Arthur Haviland. Gives a description and contents of record sheets, method of compiling and method of filing records. 3000 w. Eng News—Oct. 30, 1902. No. 51447.

We supply copies of these articles. See page 653.

STREET AND ELECTRIC RAILWAYS

Berlin.

The Underground and Elevated Electric Railways in Berlin—Now Completed and in Operation. Frank C. Perkins. Begins an illustrated detailed description of this great engineering undertaking. Serial. 1st part. 1500 w. Sci Am Sup—Nov. 1, 1902. No. 51445.

Clearing Tracks.

Removal of Snow and Ice in the Borough of Manhattan, N. Y. W. Boardman Reed. An account of past and present arrangements and methods. 2000 w. St Ry Rev—Nov. 20, 1902. No. 51816 C.

Discipline.

The Employing, Training, and Disciplining of Car-Service Employes of the Boston Elevated Ry. William A. Bancroft. Describes the methods used in choosing, training and disciplining the the motormen and conductors. 4400 w. St. Ry Rev—Nov. 20, 1902. Serial. 1st part. No. 51812 C.

Discussion.

Papers by A. H. Armstrong, W. B. Potter, and B. J. Arnold, and by C. O. Mailloux and B. J. Arnold, at Great Barrington, Mass. Papers on electric railways. 4000 w. Trans Am Inst of Elec Engrs—Aug & Sept., 1902. No. 51628 D.

Electric Locomotive.

A High-Speed Locomotive. Enrico Bignami. Illustrated description of the high-speed locomotive equipped for motors built for 10000 volts, used in the tests at high-speed on the Marienfelden-Zossen military line. 3300 w. Elec Rev, N Y—Nov. 8, 1902. No. 51646.

Electric Traction.

Electric Traction on the North-Eastern Railway of Switzerland (Elektrisch Betriebssysteme bezogenauf das Netz der Ehemaligen Nordostbahn). L. Thormann. A discussion of the availability of continuous three-phase and single-phase systems for the Swiss railways. Serial. Part I. 2000 w. Schweiz Bauzeitung—Nov. 15, 1902. No. 51952 B.

Electric Traction on the Italian Railways (La Trazione Elettrica sulle Ferrovie Italiane). G. Semenza. A discussion of the competition of the tramways with the railways for local traffic, and its effect upon the introduction of electric traction on the main lines. Serial, Part I. 2000 w. Rivista Gen d Ferrovie—Nov. 2, 1902. No. 51975 B.

Express.

Moving Small Fruits by Electric Railway. Illustrates and describes the arrangements of the International Railway Co. of Buffalo for marketing perishable farm products. 700 w. St Ry Rev—Nov. 20, 1902. No. 51814 C.

Feeders.

Transmission Lines for Electric Railways. Alton D. Adams. Discusses when direct feeding to trolley lines ceases to be good practice. 1000 w. St Ry Jour—Nov. 8, 1902. No. 51653 D.

Fender.

An Improved Fender Device for Electric Cars (Eine Neue Schulzvorrichtung für Strassenbahnwagen). A. Seyfferth. Illustrating a form of double safety fender used on the electric street railways of Düsseldorf. 1500 w. Elektrotech Zeitschr—Oct. 23, 1902. No. 51932 B.

Germany.

Electric Railways in Germany. Information relating to experiments for the reduction of vibration and noise; the use of storage battery cars for local steam lines; high-speed experiments, etc. 1500 w. Elec Rev, Lond—Nov. 7, 1902. No. 51737 A.

Grand Rapids.

Novelties on the Grand Rapids Street Railway System. Illustrates and describes devices for the reduction of labor and the improvement of the economy of operation. 1800 w. St Ry Jour—Nov. 1, 1902. No. 51577D.

Heavy Work.

An Electrical System for Heavy Railway Work. William Hand Browne, Jr. An illustrated description of the Ward Leonard System. 2500 w. Elec Rev, N Y—Nov. 22, 1902. No. 51792.

Helios Motors.

Helios Electrical Equipment of Tramcars. E. M. Collins. An illustrated description of the 20 h. p. size which is typical of all others. 2000 w. Tram & Ry Wld—Oct. 9, 1902. No. 51610 B.

Interurban.

The Bremgarten-Dietikon Interurban Electric Railway. Illustrates and describes a short interurban line in Switzerland which combines a passenger and freight business. 1200 w. St Ry Jour—Nov. 1, 1902. No. 51573 D.

The Interurban Electric Railway System of the Union Traction Co. of Indiana. An illustrated detailed description of an electric railway system aggregating 154 miles, its equipment and operation. 7800 w. Eng News—Nov. 13, 1902. No. 51686.

Paris.

Notes on Heavy Electric Traction Near

We supply copies of these articles. See page 653.

Paris. An illustrated article describing some particulars of the Paris-Orleans line, and giving details of the electric service of the Paris-Versailles line. 1600 w. St Ry Jour—Nov. 15, 1902. No. 51-710 D.

Power House.

Power House of the Berkshire Street Railway Co., Pittsfield, Mass. Illustrated detailed description. 2500 w. St Ry Rev —Nov. 20, 1902. No. 51813 C.

The Berkshire Street Railway Power House. Illustrates and describes a new generating station at Pittsfield, Mass. 2500 w. Steam Engng—Nov. 10, 1902. No. 51642.

Right of Way.

The Private Right of Way. Alton D. Adams. States the advantages of the private right of way, giving information relating to cost, and the growing appreciation, especially in Massachusetts. 2000 w. St Ry Rev—Nov. 20, 1902. No. 51815 C.

St. Louis Exposition.

The Electric Urban and Interurban Railway at the St Louis Exposition. W. E. Goldsborough. Information concerning plans for exhibits in this field, including the actual operation and test of railway equipments. 3300 St Ry Jour—Nov. 1, 1902. No. 51572 D.

Scotland.

The Rothesay Electric Tramways. Illustrated description of the electrification of a tramway on the west coast of Scotland, the reconstruction and re-equipment work. 2800 w. Tram & Ry Wld—Oct. 9, 1902. No. 51608 B.

Sleet.

Removal of Sleet from a Third Rail. George T. Hanchett. Describes methods of dealing with this serious obstacle to traffic. 1200 w. St Ry Jour—Nov. 1, 1902. No. 51575 D.

Standards.

Report of the Committee on Standards. Gives the report adopted by the American Street Railway Association, Detroit, Oct. 10, 1902. Ill. 2200 w. St Ry Jour—Nov. 15, 1902. No. 51711 D.

Statistics.

A Graphical Representation of Street Railway Statistics. W. C. Gotshall. Gives diagram showing method of plotting street railway operating statistics, stating its advantages and applications. 2000 w. St Ry Jour—Nov. 1, 1902. No. 51574 D.

Stray Currents.

The Prevention of Electrolysis. William Brophy. Extract from a paper read before the International Assn. of Fire Engrs. Considers existing conditions as affecting water mains, giving suggestions for their improvement. 2400 w. Ins Engng—Oct., 1902. No. 51539 C.

Surface Contact.

Surface Contact. Illustrations with brief description of the Dolter system. 1500 w. Elec Times—Nov. 6, 1902. No. 51718 A.

Suspension Railway.

The Elberfeld Suspension Railway. Describes the newer constructive details, the line having been built slowly, and many improvements introduced in the latest work. Also general information relating to the working of the line and its location. Map. 3000 w. Engr, Lond—Oct. 24, 1902. Serial. 1st part. No. 51489 A.

Terminals.

The Design of Street Railway Terminals. Describes and illustrates the terminals at the Pan-American exhibition at Buffalo, as well adapted for the rapid handling of crowds. 2100 w. Eng News —Oct. 30, 1902. No. 51456.

Three-Phase.

20,000-Volt Three-Phase Plant in France. P. Letheule. Illustrated detailed description of a plant in the extreme southeast of France. 3200 w. Elec Wld & Engr—Nov. 1, 1902. No. 51566.

Tramways.

The Development of Electric Tramways (Ueber die Entwicklung der Elektrischen Bahnen). Karl Hochenegg. With many diagrams showing the growth of electric traction in the various countries of Europe and the builders thereof. 8000 w. Zeitschr d Oesterr Ing u Arch Ver—Oct. 31, Nov. 7,. No. 51922 each B.

Valtelline.

Electric Traction on the Valtelline Railway (La Trazione Elettrica sulle Ferrovie della Valtellina). E. Fumero. A very complete account of the road and its equipment and of the hydro-electric power station at Morbegno. 8000 w. L'Elettricita —Nov. 2, 1902. No. 51974 B.

Some Features of the Valtellina Three-Phase Railway. Cesare Pio. Illustrated description of interesting features of a very successful line. 1600 w. Elec Wld & Engr—Nov. 1, 1902. No. 51565.

Wales.

The Great Orme Tramways. Illustrated description of a mountain railway in Wales, having steep gradients and sharp curves, worked by cable. 2100 w. Tram & Ry Wld—Oct. 9, 1902. No. 51609 B.

Zurich.

The Street Railway System of Zurich. An illustrated detailed description of the construction and operation of a system owned by the city of Zurich, Switzerland. 3900 w. St Ry Jour—Nov. 1, 1902. No. 51571 D.

We supply copies of these articles. See page 653.

EXPLANATORY NOTE—THE ENGINEERING INDEX.

We hold ourselves ready to supply—usually by return of post—the full text of every article indexed in the preceding pages, *in the original language*, together with all accompanying illustrations; and our charge in each case is regulated by the cost of a single copy of the journal in which the article is published. The price of each article is indicated by the letter following the number. When no letter appears, the price of the article is 20 cts. The letter A, B or C denotes a price of 40 cts.; D, of 60 cts.; E, of 80 cts.; F, of $1.00; G, of $1.20; H, of $1.60. In ordering, care should be taken to *give the number* of the article desired, not the title alone.

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THE PUBLICATIONS REGULARLY REVIEWED AND INDEXED.

The titles and addresses of the journals regularly reviewed are given here in full, but only abbreviated titles are used in the Index. In the list below, *w* indicates a weekly publication, *b-w*, a bi-weekly, *s-w*, a semi-weekly, *m*, a monthly, *b-m*, a bi-monthly, *t-m*, a tri-monthly, *qr*, a quarterly, *s-q*, semi-quarterly, etc. Other abbreviations used in the index are: Ill—Illustrated; W—Words; Anon—Anonymous.

Alliance Industrielle. *m.* Brussels.
American Architect. *w.* Boston.
American Electrician. *m.* New York.
Am. Engineer and R. R. Journal. *m.* New York.
American Gas Light Journal. *w.* New York.
American Jl. of Science. *m.* New Haven, U.S.A.
American Machinist. *w.* New York.
Am. Manuf. and Iron World. *w.* Pittsburg, U. S. A.
American Shipbuilder. *w.* New York.
American Telephone Journal. *w.* New York.
Annales des Ponts et Chaussées. *m.* Paris.
Ann. d Soc. d Ing. e d Arch. Ital. *w.* Rome.
Architect. *w.* London.
Architectural Record. *qr.* New York.
Architectural Review. *s-q.* Boston.
Architect's and Builder's Magazine. *m.* New York.
Armee und Marine. *w.* Berlin.
Australian Mining Standard. *w.* Sydney.
Autocar. *w.* Coventry, England.
Automobile Magazine. *m.* New York.
Automotor & Horseless Vehicle Jl. *m.* London.
Brick Builder. *m.* Boston.
British Architect. *w.* London.
Brit. Columbia Mining Rec. *m.* Victoria, B. C.
Builder. *w.* London.
Bulletin American Iron and Steel Asso. *w.* Philadelphia, U. S. A.
Bulletin de la Société d'Encouragement. *m.* Paris.
Bulletin of Dept. of Labor. *b-m.* Washington.
Bulletin Scientifique. *m.* Liege.
Bull. Soc. Int. d Electriciens. *m.* Paris.
Bulletin of the Univ. of Wis., Madison, U. S. A.
Bull. Int. Railway Congress. *m.* Brussels.
Canadian Architect. *m.* Toronto.
Canadian Electrical News. *m.* Toronto.
Canadian Engineer. *m.* Montreal.
Canadian Mining Review. *m.* Ottawa.
Chem. Met. Soc. of S. Africa. *m.* Johannesburg.
Colliery Guardian. *w.* London.
Compressed Air. *m.* New York.
Comptes Rendus de l'Acad. des Sciences. *w.* Paris.
Consular Reports. *m.* Washington.
Contemporary Review. *m.* London.
Deutsche Bauzeitung. *b-w.* Berlin.
Domestic Engineering. *m.* Chicago.
Electrical Engineer. *w.* London.
Electrical Review. *w.* London.
Electrical Review. *w.* New York.
Electrical World and Engineer. *w.* New York.
Electrician. *w.* London.
Electricien. *w.* Paris.
Electricity. *w.* London.
Electricity. *w.* New York.
Electrochemist & Metallurgist. *m.* London.

Elektrizität. *b-w.* Leipzig.
Elektrochemische Zeitschrift. *m.* Berlin.
Elektrotechnische Zeitschrift. *w.* Berlin.
Elettricita. *w.* Milan.
Engineer. *w.* London.
Engineer. *s-m.* Cleveland, U. S. A.
Engineering. *w.* London.
Enginering and Mining Journal. *w.* New York.
Enginering Magazine. *m.* New York & London.
Engineering News. *w.* New York.
Engineering Record. *w.* New York.
Eng. Soc. of Western Penna. *m.* Pittsburg, U.S.A.
Fire and Water. *w.* New York.
Foundry. *m.* Cleveland, U. S. A.
Gas Engineers' Mag. *m.* Birmingham.
Gas World. *w.* London.
Génie Civil. *w.* Paris.
Gesundheits-Ingenieur. *s-m.* München.
Giorn. Dei Lav. Pubb. e. d. Str. Ferr. *w.* Rome.
Glaser's Ann. f Gewerbe & Bauwesen. *s-m.* Berlin.
Horseless Age. *w.* New York.
Ice and Refrigeration. *m.* New York.
Ill. Zeitschr. f. Klein u. Straussenbahnen. *s-m* Berlin.
Indian and Eastern Engineer. *m.* Calcutta.
Ingeneria. *b-m.* Buenos Ayres.
Ingenieur. *w.* Hague.
Insurance Engineering. *m.* New York.
Iron Age. *w.* New York.
Iron and Coal Trades Review. *w.* London.
Iron and Steel Trades Journal. *w.* London.
Iron Trade Review. *w.* Cleveland, U. S. A.
Jour. Am. Foundrymen's Assoc. *m.* New York.
Journal Asso. Eng. Societies. *m.* Philadelphia.
Journal of Electricity. *m.* San Francisco.
Journal Franklin Institute. *m.* Philadelphia.
Journal of Gas Lighting. *w.* London.
Journal Royal Inst. of Brit. Arch. *s-qr.* London.
Journal of Sanitary Institute. *qr.* London.
Journal of the Society of Arts. *w.* London.
Journal of U. S. Artillery *b-m.* Fort Monroe, U.S.A.
Journal Western Soc. of Eng. *b-m.* Chicago.
Journal of Worcester Poly. Inst., Worcester, U.S.A.
Locomotive. *m.* Hartford, U. S. A.
Locomotive Engineering. *m.* New York.
Machinery. *m.* London.
Machinery. *m.* New York.
Madrid Cientifico. *t-m.* Madrid.
Marine Engineering. *m.* New York.
Marine Review. *w.* Cleveland, U. S. A.
Mem. de la Soc. des Ing. Civils de France. *m.* Paris.
Metallographist. *qr.* Boston.
Metal Worker. *w.* New York.
Métallurgie. *w.* Paris.
Minero Mexicano. *w.* City of Mexico.
Minerva. *w.* Rome.
Mines and Minerals. *m.* Scranton, U. S. A.
Mining and Sci Press. *w.* San Francisco.
Mining Journal. *w.* London.
Mining Reporter. *w.* Denver, U. S. A.
Mitt. aus d Kgl Tech. Versuchsanst. Berlin.
Mittheilungen des Vereines für die Förderung des Local und Strassenbahnwesens. *m.* Vienna.
Modern Machinery. *m.* Chicago.
Monatsschr. d Wurtt. Ver. f Baukunde. *m.* Stuttgart.
Moniteur Industriel. *w.* Paris.
Mouvement Maritime. *w.* Brussels.
Municipal Engineering. *m.* Indianapolis, U. S. A.
Municipal Journal and Engineer. *m.* New York.
National Builder. *m.* Chicago.
Nature. *w.* London.
Nautical Gazette. *w.* New York.
New Zealand Mines Record. *m.* Wellington.
Nineteenth Century. *m.* London.
North American Review. *m.* New York.
Oest. Wochenschr. f. d. Oeff Baudienst. *w.* Vienna.
Oest. Zeitschr. Berg- & Hüttenwesen. *w.* Vienna.
Ores and Metals. *w.* Denver, U. S. A.
Plumber and Decorator. *m.* London.
Popular Science Monthly. *m.* New York.
Power. *m.* New York.
Power Quarterly. New York.
Practical Engineer. *w.* London.
Pro. Am. Soc. Civil Engineers. *m.* New York.
Procedings Engineers' Club. *qr.* Philadelphia.
Pro. St. Louis R'Way Club. *m.* St. Louis, U. S. A.
Progressive Age. *s-m.* New York.
Quarry. *m.* London.
Queensland Gov. Mining Jour. *m.* Brisbane, Australia.
Railroad Digest. *w.* New York.
Railroad Gazette. *w.* New York.
Railway Age. *w.* Chicago.
Railway & Engineering Review. *w.* Chicago.
Review of Reviews. *m.* London & New York.
Revista d Obras. Pub. *w.* Madrid.
Revista Tech. ed Agr. *b-m.* Catania.
Revista Tech. Ind. *m.* Barcelona.
Revue de Mécanique. *m.* Paris.
Revue Gen. des Chemins de Fer. *m.* Paris.
Revue Gen. des Sciences. *w.* Paris.
Revue Technique. *b-m.* Paris.
Revue Universelle des Mines. *m.* Liége.
Rivista Gen. d Ferrovie. *w.* Florence.
Rivista Marittima. *m.* Rome.
Sanitary Plumber. *s-m.* New York.
Schiffbau. *s-m.* Berlin.
Schweizerische Bauzeitung. *w.* Zürich.
Scientific American. *w.* New York.
Scientific Am. Supplement. *w.* New York.
Stahl und Eisen. *s-m.* Düsseldorf.
Steam Engineering. *m.* New York.
Stevens' Institute Indicator. *qr.* Hoboken, U.S.A.
Stone. *m.* New York.
Street Railway Journal. *m.* New York.
Street Railway Review. *m.* Chicago.
Telephone Magazine. *m.* Chicago.
Telephony. *m.* Chicago.
Tijds. v h Kljk. Inst. v Ing. *qr.* Hague.
Tramway & Railway World. *m.* London.
Trans. Am. Ins. Electrical Eng. *m.* New York.
Trans. Am. Ins. of Mining. Eng. New York.
Trans. Am. Soc. of Civil Eng. *m.* New York.
Trans. Am. Soc. of Heat & Ven. Eng. New York.
Trans. Am. Soc. Mech. Engineers. New York.
Trans. Inst. of Engrs. & Shipbuilders in Scotland, Glasgow.
Transport. *w.* London.
Western Electrician. *w.* Chicago.
Wiener Bauindustrie Zeitung. *w.* Vienna.
Yacht. *w.* Paris.
Zeitschr. d. Oest. Ing. u. Arch. Ver. *w.* Vienna.
Zeitschr. d. Ver. Deutscher Ing. *w.* Berlin.
Zeitschrift für Elektrochemie. *w.* Halle a S.

CURRENT RECORD OF NEW BOOKS

NOTE—Our readers may order through us any book here mentioned, remitting the publisher's price as given in each notice. Checks, Drafts, and Post-Office Orders, home and foreign, should be made payable to THE ENGINEERING MAGAZINE.

Civil Engineer's Pocket-Book.

The Civil Engineer's Pocket Book. By John C. Trautwine, John C. Trautwine, Jr., and John C. Trautwine, 3d. Eighteenth Edition. Size 8 in. by 5½ in.; pp. xxxii, 1079. Price $5.00 (21 shillings). New York: John Wiley & Sons. London: Chapman & Hall, Ltd. 1902.

Trautwine's pocket book needs no commendation or praise, the fact that it has reached its eighteenth edition and seventieth thousand being sufficient evidence of the manner in which it is appreciated by the profession to which it is addressed, and for which it has been the standard book of reference for many years. The present edition represents a very thorough revision, with he inclusion of much new matter and the omission of such portions as had become obsolete. The new matter is of much value, including as it does most complete conversion tables, both of simple and compound dimensions in the English and metric systems, improved tables of logarithms, data concerning the strength of materials, revision of matter on statics, beams, and trusses, and much other useful information. More than 370 pages of new matter have been added, and the whole book has been vastly increased in value by the careful and judicious work which has been done. The value of the earlier editions of this standard work must always be appreciated, but the present revised edition is a book which every civil engineer should possess and use.

Electrical Dictionary.

Handy Electrical Dictionary. Compiled and edited by W. L. Weber, M. E. Size, 6 by 2½ in.; pp. 224; diagrams, 45. Price, 50 cents. Chicago: Frederick J. Drake & Co.

A very convenient little reference book, which can be carried in a vest pocket. The definitions are, in general, simple and correct, and in many cases the explanations of terms go further than the bare definition of a word. The list of words is as complete as the limited space permits, and some of the conventional diagrams used in electrical work are also given, such as those representing different types of electrical apparatus.

Magnetic Tables.

United States Magnetic Declination Tables and Isogonic Charts for 1902 and Principal Facts Relating to the Earth's Magnetism. By L. A. Bauer. Size, 11½ by 8 in.; pp. 405; figures and illustrations, 29; charts, 2. Washington: U. S. Coast Geodetic Survey, Treasury Department.

The deservedly high reputation of the U. S. Coast Survey for useful scientific work will not be diminished by the present publication by its chief of the division of terrestrial magnetism. This volume is a continuation of the series of papers, begun in 1855, treating of the magnetic declination in the United States. The previous papers contained the magnetic declination tables and the accompanying charts of lines of equal magnetic declination (isogonic charts) for various epochs up to 1900. The results of observations are here brought down to Jan. 1, 1902, and this publication will, when necessary, be followed by others, so bringing the records up to date. The magnetic declination tables, forming the main body of this book, contain about 8,000 entries, and are the most complete tabular presentation of declination values in the United States. The charts contain the lines of equal magnetic declination in the United States and in Alaska, and, for the United States, in addition the "lines of equal annual change." There is a chapter on methods for determining meridian lines and the magnetic declination, and another one setting forth the facts concerning the secular change of the magnetic declination in the United States and outlying territories. A very interesting historical and descriptive essay on the earth's magnetic phenomena and the compass opens this volume, which thus covers its field very completely and is of the greatest value to all who are concerned with the study of the earth's magnetism.

Mechanics—Problems.

Mechanics—Problems for Engineering Students. By Frank B. Sanborn. Size, 8 by 5½ in.; pp. 155; illustrations, 15; figures, 47. Price, $1.50. New York: The Engineering News Publishing Co.

This book is filled with live problems. Its author, the professor of civil engineer-

ing in Tufts College, has made a judicious selection from modern examination papers and up-to-date text books, but the most characteristic problems are those taken from every-day engineering practice, the realistic effect of the latter being increased by illustrations. The author is convinced that the main object of a course in mechanics should be to prepare a student to solve its problems, and the five hundred examples in this book are chosen with this end in view. They have been grouped under the three general heads of work, force and motion, and there are various subsections, at the beginning of each of which a typical problem is worked out to explain the method and illustrate the principles involved. The student in handling these problems, will feel that he is dealing with real things, of the same nature that will confront him in his engineering career.

Municipal Sociology.

American Municipal Progress. Chapters in Municipal Sociology. By Charles Zueblin, Professor of Sociology in the University of Chicago. Size, 7½ by 5 in.; pp. 380. Price, $1.25. New York: The Macmillan Company. London: Macmillan and Co., Ltd.

These chapters give an interesting survey of the broadening and quickening activities of American city life. They show what progress has been made, notably within the past decade, in transportation, sanitation, schools, libraries, public buildings, parks and boulevards, public recreation and other departments of municipal administration. Throughout the book there is a sentiment in favor of municipal ownership, which finds definite expression in the last chapter, on "public control, ownership and operation." But without entering into a discussion of the means by which the advance has been gained and by which progress will be made, it must be admitted that although American cities are yet very far from the ideal municipality which is sketched on these pages, the work which has been done and the spirit which has been aroused give every hope for the future.

Naval Architect's Pocket-Book.

The Naval Architect's and Shipbuilder's Pocket-Book of Formulæ, Rules and Tables, and Marine Engineer's and Surveyor's Handy Book of Reference. By Clement Mackrow. Size, 6½ by 4¼ in.; pp. X, 750; figures, 314. Price, $5. New York: D. Van Nostrand Company. London: Crosby, Lockwood & Son.

The object of this work is to supply all who are connected professionally with shipbuilding with a pocket-book which shall contain all the ordinary formulæ, rules and tables required by them. This matter, before the appearance of the pocket-book, was scattered in various places and some of it was difficult of access, but it has now been carefully gathered and cast into convenient form, and the mere fact that the present is the eighth edition of the work shows that the book has been thoroughly appreciated. In this edition, about fifty pages of new matter have been added, and the volume has been carefully rearranged and revised up to date. The principal tables have been placed together at the end of the book, and among other interesting features is a vocabulary of naval and shipbuilding technical terms, in French and English. This work is to the naval architect and shipbuilder what Trautwine's pocket-book is to the civil engineer, Kent's to the mechanical engineer and Foster's to the electrical engineer.

Slide Valve.

The Slide-Valve and Its Functions, with Special Reference to Modern Practice in the United States. By Julius Begtrup, M. E. Size, 9 in. by 6 in.; pp. 143; diagrams and illustrations, 90. Price, $2. New York: D. Van Nostrand Company. London: E. & F. N. Spon, Ltd.

Besides the common slide-valve, piston valves, Corliss valves, semi-rotary or oscillating valves and other valves whose sliding surfaces are cylindrical, are included in this treatise. Typical pump valves, as well as steam-engine valves, are also considered. A great many valves in practical use are described and well illustrated, and diagrams are shown wherever advisable, as it is believed, with good reason, that verbal treatment should be supplemented by graphical representation. A successful endeavor has been made to present the subject matter in a condensed form, as being best adapted to the requirements of practical men, and the author has in this respect followed the suggestions of an extensive personal experience.

BOOKS ANNOUNCED.

Trades Waste, With Special Reference to the Prevention of River Pollution. By W. Naylor, F. C. S., A. M. Inst. C. E. Price, $6.50. New York: D. Van Nostrand Company.

Irrigation Institutions. By Elwood Mead, C. E., M. S. Price, $1.25. New York: The Macmillan Company.

Year Book for Texas for 1902-3. Edited and published by C. W. Raines, Austin, Tex. pp. 440. Price, $2.

Furnace Draft: Its Production by Mechanical Methods. By William Wallace Christie, M. E. Hand-book size; pp. 52. Illust. Price, 50 cents. New York: D. Van Nostrand Company.

Metallurgical Laboratory Notes. By Prof. H. M. Howe. Price, $2.50. Boston, Mass.: Boston Testing Laboratories.

NEWS SUPPLEMENT

The Engineering Magazine—January, 1903

Coming Society Meetings.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. Sec.: Prof. L. O. Howard, Cosmos Club, Washington, D. C. Annual meeting, Dec. 29 to Jan. 3, Washington.

AMERICAN BOILER MANUFACTURERS' ASSOCIATION. Sec.: J. D. Farasey, Cleveland. Next meeting, July, 1903, at Chattanooga.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Sec.: Ralph W. Pope, 95 Liberty St., New York. Regular meeting on fourth Friday of each month, 12 W. 31st St., New York. Jan. 23: Paper on "Telephone Exchanges."

AMERICAN RAILWAY ASSOCIATION. Sec.: W. F. Allen, 24 Park Place, New York. Meeting, April 22, 1903, New York.

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE OF WAY ASSOCIATION. Sec.: L. C. Fritch, Cincinnati. Annual meeting, March 17 and 18, Chicago.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION. Sec.: J. W. Taylor, 667 Rookery, Chicago. Meeting, June, 1903.

AMERICAN SOCIETY OF CIVIL ENGINEERS. Sec.: C. W. Hunt, 220 W. 57th St., New York. Regular meetings, first and third Wednesdays of each month. Annual meeting, Jan. 21 and 22, 1903.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Sec.: Prof. F. R. Hutton, 12 W. 31st St., New York. Semi-annual meeting, June, at Saratoga.

BOSTON SOCIETY OF CIVIL ENGINEERS. Sec.: S. E. Tinkham, 715 Tremont Temple. Regular meetings on third Wednesday of each month, except January, when on fourth Wednesday.

CANADIAN RAILWAY CLUB. Sec.: W. H. Rosevear, Jr., Montreal. Regular meetings on second Tuesday of each month.

CANADIAN SOCIETY OF CIVIL ENGINEERS. Sec.: Prof. C. H. McLeod, 877 Dorchester St., Montreal. Regular meetings every alternate Thursday. Annual meeting, Jan. 27, 1903.

CENTRAL RAILWAY CLUB. Sec.: Harry D. Vought, 62 Liberty St., New York. Regular meetings on second Fridays of Jan., March, May, Sept. and Nov., Hotel Iroquois, Buffalo.

CHICAGO ELECTRICAL ASSOCIATION. Sec.: W. J. Warder, Jr., 900 Warren Ave. Regular meetings on first Friday of each month.

CIVIL ENGINEERS' CLUB OF CLEVELAND. Sec.: Arthur A. Skeels, 689 The Arcade. Regular meetings on second and fourth Tuesdays of each month.

CIVIL ENGINEERS' SOCIETY OF ST. PAUL. Sec.: G. S. Edmondstone. Regular meetings on second Monday of each month.

ENGINEERING ASSOCIATION OF THE SOUTH. Sec.: H. M. Jones, 1000 Broad St., Nashville, Tenn. Regular meetings on second Thursday of each month at Vanderbilt University.

ENGINEERS' CLUB OF CHICAGO. Sec.: B. W. Thurtell, 1223 New York Life Building. Regular meetings on first and third Tuesdays of each month.

ENGINEERS' CLUB OF CINCINNATI. Sec.: J. F. Wilson. P. O. Box 333. Regular meetings on third Thursday of each month.

ENGINEERS' CLUB OF COLUMBUS (OHIO). Sec.: H. M. Gates, 12½ North High St. Regular meetings on first and third Saturdays of each month.

ENGINEERS' CLUB OF MINNEAPOLIS. Sec.: Edw. P. Burch, 1210 Guaranty Bldg. Regular meetings on third Monday of each month.

ENGINEERS' CLUB OF PHILADELPHIA. Sec.: L. F. Rondinella, 1122 Girard St. Regular meetings on first and third Saturdays of each month.

ENGINEERS' CLUB OF ST. LOUIS. Sec.: D. W. Roper, 920 Rialto Bldg. Regular meetings on first and third Wednesdays of each month.

ENGINEERS' SOCIETY OF WESTERN NEW YORK. Sec.: L. W. Eighmy, 13 City Hall, Buffalo. Regular meetings, first Tuesday of each month.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA. Sec.: Chas. W. Ridinger, 410 Penn Ave., Pittsburg. Regular meetings on third Tuesday of each month.

FRANKLIN INSTITUTE. Sec.: Dr. Wm. H. Wahl, 15 South 7th St., Philadelphia. General meetings on third Wednesday of each month. Regular monthly meetings of the various sections on other days.

IOWA RAILROAD CLUB. Sec.: P. B. Vermillion, Des Moines, Iowa. Regular meetings on third Tuesday of each month.

LOUISIANA ENGINEERING SOCIETY. Sec.: G. W. Lawes, 806 Gravier St., New Orleans. Regular meetings on the second Monday of each month. Annual meeting, Jan. 10.

MASTER CAR BUILDERS' ASSOCIATION. Sec.: J. W. Taylor, 667 Rookery, Chicago. Meeting, June, 1903.

MICHIGAN ENGINEERING SOCIETY. Sec.: F. Hodgman, Climax, Mich. Annual meeting, Jan. 20, 21 and 22 at Battle Creek.

MODERN SCIENCE CLUB. Sec.: R. Henderson, 302 Livingston St., Brooklyn. Meetings every Tuesday.

MONTANA SOCIETY OF ENGINEERS. Sec.: Richard R. Vail, Butte, Mont. Regular meetings on second Saturday in each month.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Sec.: James B. Cahoon, 136 Liberty St., New York. Meeting, May, 1903, Chicago.

NEW ENGLAND RAILROAD CLUB. Sec.: Edw. L. Janes, Back Bay P. O., Boston. Regular meetings second Tuesday in each month at Pierce Hall, Copley Square.

NEW YORK RAILROAD CLUB. Sec.: W. B. Yereance, 418 Center St., South Orange, N. J. Regular meetings on third Friday of each month except June, July and August, at Carnegie Hall, 154 W. 57th St., New York.

NORTH-WEST RAILWAY CLUB. Sec.: T. W. Flannagan, Minneapolis, Minn. Regular meetings on first Tuesday after second Monday of each month, alternating between Minneapolis and St. Paul.

PACIFIC COAST RAILWAY CLUB. Sec.: C. C. Borton, West Oakland, Cal. Regular meetings on third Saturday of each month, at San Francisco.

PACIFIC NORTHWEST SOCIETY OF ENGINEERS. Meetings monthly in Chamber of Commerce rooms, Seattle, Wash.

RAILWAY CLUB OF PITTSBURGH. Sec.: J. D. Conway, P. & L. E. R. R., Pittsburgh, Pa. Regular meetings on fourth Friday of each month at Hotel Henry.

RAILWAY SIGNALING CLUB. Sec.: B. B. Adams, 32 Park Place, New York. Regular meetings on second Tuesday of January, March, May, Sept. and Nov.

RICHMOND RAILROAD CLUB. Sec.: F. O. Robinson, 8th & Main Sts., Richmond, Va. Regular meetings on second Thursday of each month.

ROCKY MOUNTAIN RAILWAY CLUB. Sec.: J. E. Buell, 906 20th Ave., Denver. Regular meetings on first Saturday after the 15th of each month.

ST. LOUIS RAILWAY CLUB. Sec.: E. A. Chenery, Union Station, St. Louis. Regular meetings on second Friday of each month.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB. Sec.: W. A. Love, Atlanta, Ga. Regular meetings on third Thursday of Jan., April, Aug. and Nov.

TECHNICAL SOCIETY OF THE PACIFIC COAST. Sec.: Otto von Geldern, 31 Post St., San Francisco. Regular meetings on first Friday of each month.

TEXAS RAILWAY CLUB. Sec.: T. H. Osborne, Pine Bluff, Ark. Regular meetings on third Monday of April and September.

WESTERN RAILWAY CLUB. Sec.: Jos. W. Taylor, 667 Rookery, Chicago. Meetings on third Tuesday of each month, Auditorium Hotel, Chicago.

WESTERN SOCIETY OF ENGINEERS. Sec.: J. H. Warder, Monadnock Block, Chicago. Regular meetings on first Wednesday and extra meetings on third Wednesday of each month.

Personal.

—The American Society of Mechanical Engineers elected the following officers at its December meeting in New York: President, James M. Dodge, Philadelphia; vice-presidents, F. H. Daniels, Worcester; James Christie, Philadelphia, and John R. Freeman, Providence; managers, R. C. McKinney, New York; S. S. Webber, Trenton, and Newell Sanders, Chattanooga; treasurer, William H. Wiley, New York.

—Mr. Edwin Reynolds, the great designer of steam engines, past-president of the American Society of Mechanical Engineers, for many years general superintendent of the Edward P. Allis Co., and more recently chief engineer of the consolidated Allis-Chalmers Co., has been made consulting engineer of the latter company, and his nephew, Mr. Irving H. Reynolds, M. Am. Soc. C. E., who has been the general superintendent, succeeds him as chief engineer.

—Mr. Desmond Fitzgerald, past-president of the American Society of Civil Engineers, who has been connected with the Boston Water-Works Department for many years, has resigned from his position as engineer of the Sudbury Department of the Metropolitan Water and Sewerage Board, on account of ill health.

—Mr. Kingsley L. Martin, the assistant engineer of the East River Bridge, who displayed such striking gallantry at the time of the fire on the bridge tower, has received a letter from Mayor Low, in which the latter expresses his high appreciation of Mr. Martin's conduct on that occasion.

—Mr. Eduardo J. Chibas, C. E., who has had a large experience as civil and mining engineer in this country and in Central and South America, and who has recently been manager of the Guantanamo and Caimanera Railway, Cuba, has established an office in Santiago de Cuba, where he will devote special attention to the examination of mining properties on the island.

—Herr Theodore Lewald has been appointed imperial commissioner for Germany to the World's Fair at St. Louis in 1904. He is authorized to select a site and arrange for the construction of the German building, and when this is completed he will start the work of collecting exhibits.

—Mr. E. B. Thomas was elected president of the Lehigh Valley Railroad Com-

pany, and Mr. J. A. Middleton, assistant to the president, at a recent meeting of the board of directors. Mr. Middleton's office will be at No. 26 Cortlandt Street, New York.

—Mr. Charles Parsons, who has been engaged in railroad mechanical work and in the sale of engineering and railroad supplies, has now joined the Chicago Pneumatic Tool Co. and will travel for them in the interests of their products.

Messrs. Dodge & Day, modernizing engineers, will equip the new plant which is being erected for the Heating, Ventilating and Foundry Co., of Pittsburg, at Wheeling, West Va.

—Mr. Salem Howe Wales, the managing editor of the "Scientific American" for many years, died at his home in New York on December 2, at the age of seventy-seven.

—Mr. C. O. Tilton, the secretary of the Railway Signaling Club, who was signal inspector for the Chicago, Milwaukee & St. Paul Railway and had charge of the mechanical part of the signal work of that road, died on Nov. 12, at West Milwaukee, Wis.

Industrial Notes.

—The Cochran-Bly Machine Works, of Rochester, N. Y., the manufacturers of die-making machinery, have recently moved to their new factory on Griffith Street.

—The Harrisburg Foundry & Machine Works announce that the interests of this company centering in and about its New York office, 203 Broadway, and at present under the capable management of Mr. W. P. Mackenzie, having prospered and expanded beyond expectation, will be conducted, hereafter, by the firm of Mackenzie and Quarrier.

—The Cooper-Hewitt Electric Company of New York has been incorporated at Albany with a capital of $2,000,000, to manufacture vapor electric lamps. The directors are: Charles B. Hill, John F. Symes, G. H. Stockbridge, Charles H. O'Connor, and Leavitt J. Hunt, all of New York City.

—The National Machinery Co., of Tiffin, Ohio, reports that business in the bolt, nut and special machinery trade has recently been exceptionally good. Judging from the orders on hand and the inquiries received, and considering the fact that this has been the dull season, the company looks for a large volume of business for 1903. Rumors of decreasing trade are not substantiated, and the company's plant is running to its full capacity to take care of the business in what promises to be the largest year in its history. Foreign trade is picking up, and very substantial orders have been received from France and Germany.

—The New York Continental Jewell Filtration Co. report that they have closed a contract with the Maharaja of Mysore, India, through Captain A. J. de Lotbiniere, Royal Engineers, British Army, who was sent from India to New York by his government for that purpose. The filter plant is to consist of four Jewell gravity filters, each 20 feet in diameter, constructed of granite laid in Portland cement. There will be a masonry subsidence basin holding 400,000 imperial gallons. The capacity of the filter plant is to be 2,600,000 U. S. gallons. It will be erected early in the spring by one of the Filter Company's engineers. It is to be located at Bowringpet in the Kolar Gold Fields, near Bangalore, Mysore. Mr. E. B. Weston, Am. Soc. C. E., is the consulting engineer.

—The Philadelphia Pneumatic Tool Co. has just completed the equipment of Kaiser Wilhelm's new navy yard at Kiel, Germany, with an outfit of Keller pneumatic tools. This is the latest phase of the American commercial invasion of Europe. Looking in the opposite direction, this company reports an increasing trade on the Pacific Coast. Mr. O. A. Berger, the representative of the Philadelphia Company in San Francisco, has just visited the home office, bringing with him some large orders from the various ship yards, steel works, etc., on the Pacific Coast.

—The Crocker Wheeler Company, of Ampere, N. J., manufacturers of electrical machinery, have included among their recent shipments of engine-type generators one size 336, 400 K. W. for the Stephen Girard Building, Philadelphia; one size 111, 100 K. W., and one size 140, 125 K. W. for the Missouri Pacific Railway, St. Louis; two size 168, 150 K. W. for the Penna. Malleable Co., McKees Rocks, Pa.; one size 224, 200 K. W., for J. L. Mitchell, Philadelphia; two size 168, 150 K. W., one size 224, 200 K. W., and one size 84, 75 K. W., for the

Woodward & Lothrop Bldg, Washington, D. C. The company report that their new mill building is now being occupied, enlarging their floor space by 60,000 square feet, and thus giving increased facilities for prompt deliveries on large orders.

—The Western Electric Co. are now western selling agents for the house goods specialties manufactured by Edwards & Co., of New York, and are carrying a stock in Chicago of all the more important items. The line of burglar alarm springs, door openers, bells and watchmen's clocks is well known, and to these specialties have been added automobile bells, monitor bells and electric-light door switches; a practical line —the result of practical experience. The special catalogue of these goods is a very convenient and necessary reference book, and a copy with discount sheet will be sent upon request.

—The Standard Water Meter Co., of 245 to 249 Robinson street, Brooklyn, report that they are having quite a call for hot-water meters. They attribute this demand partly to the excessive price of coal, but it also speaks well for the prudent engineer who is watching his boiler. They make these meters, which are very simple and compact and can be readily attached to any feed pipe, in all sizes from ¾ inch to 6 inches.

—The Parker steam generator was the principal subject of an address by Prof. O. P. Hood, of the Michigan College of Mines, on "A Boiler Built on a Neglected Principle in Boiler Design." This principle, consisting in bringing the hottest gases in contact with the hottest part of the fluid, and, as the temperature of the gases falls, letting them meet cooler and cooler portions of the fluid, has been embodied in the Parker boiler, whch is manufactured by the Parker Engine Co. of California, whose general office is in the Drexel Building, Philadelphia. One of the most important features of this boiler is the manner in which it handles the scale. The Roach boiler at Chester has been running for over two and a half years and has never had a tube cleaned or renewed. The scale forms in the lower tubes only, it cracks off, is carried out and up by the flow and is deposited in the upper drum. The Philadelphia Rapid Transit Co. boiler has been running for four months on unpurified Schuylkill water, and it is clearing itself of the scale in the same manner. A recent inspection which was witnessed by representatives of the Baldwin Locomotive Works, the United Gas Improvement Co., the Pennsylvania R. R., and others, showed about 200 pounds of loose scale in the drums which had been washed out of the tubes. The tubes were pronounced clean, although there is always some scale in the lower tubes in spots.

—The Chicago Pneumatic Tool Company report the business outlook to be first class in practically all civilized countries; their extensive connections in all countries keep them in close touch with the business situation, so that they are well suited to judge of the general conditions everywhere. Some recent changes have been made by them in their representatives in this country. Mr. Geo. A. Barden, who has been representing the company at Buffalo, has been transferred to the Philadelphia field, and Mr. C. R. Green, who has been connected with the Cleveland office of the company, has succeeded Mr. Barden in Buffalo. Mr. Chas. Parsons, who recently became connected with the company, is now traveling in the Northwest. Mr. J. W. Duntley, president of the Chicago Pneumatic Tool Company, who has been spending some time in Europe, is returning to America with a large number of orders induced by their rapidly increasing trade there.

—The Vulcan Detinning Company has issued, through its board of directors, a statement of its recent operations, which shows a very satisfactory condition of affairs. The products of the mills of this company, situated at Sewaren, N. J., and Streator, Ill., are "merchantable pig-tin" and "steel scrap," the latter used by steel mills. These articles are converted by various processes from tin-plate clippings. There is a demand for them at all times, and contracts for the output of these mills extend well into the year 1903.

—The Snoqualmie Falls and White River Power Co. is constructing a new hydro-electric plant in addition to the famous station at Snoqualmie Falls, Wash. The new plant is situated in the Stuck River valley, not far from Tacoma. Its general plan will be to divert the water of White River at a point in the southwest quarter of Section 35, Township 20, North Range, 6 East, in Pierce

County, Washington, and to convey the waters thus diverted through an excavated canal, a distance of about 8 miles to Lake Tapps. The level of this lake will be raised until it occupies an area of about 5,000 acres and will serve as a storage reservoir and settling basin. The outlet of this reservoir will be a short canal and tunnel connecting with a penstock on the brow of the hill overlooking the Stuck Valley. Steel pipes leading from the penstock will convey the water under a head of 450 feet to the water-wheels in the power house at the foot of the hill; and from the water-wheels the water will escape through a short tail race into Stuck River. The power house will be connected in with the present Snoqualmie Falls transmission system by circuits about 5 miles in length, and is designed to accommodate a 50,000 horse-power installation of water-wheels, generators and accessories, although at present it will be erected in part only, sufficient to house a 10,000-horse-power installation of water-wheels and generators. As an adjunct, there will be a machine shop equipped with a lathe, drill press, shaper and blacksmith forge with the necessary accessories. There will be installed in the power-house two 3,000-kilowatt generators and two exciters of the Westinghouse type, directly connected to impact water-wheels of sufficient capacity to drive the generators under full load.

—The American Blower Co., of Detroit, Mich., report a number of large orders on their books, among which they mention contracts for heating apparatus for the Iron City Sanitary Mfg. Co., Zelinople, Pa., Enterprise Mfg. Co., Columbiana, O.; B. F. Lee Co., Braddock, Pa., Monongahela (Pa.) Forge & Furnace Co., New York Glucose Co., Edgewater, N. J.; and the Michigan Malleable Iron Co., Detroit; and contracts for mechanical draft apparatus for the International Paper Co.'s Corinth, N. Y., mill; Geo. H. Hammond Co., Chicago; Lehigh Valley Coal Co., New York; Princeton University, and the Binghamton (N. Y.) Electric Light & Power Co.

—A bill has recently been sanctioned by Parliament, which gives authority for an extensive power distribution scheme contemplating the supplying of power to the industrial region of the lower Clyde River in Scotland. The district covered by the bill includes that part of the Clyde Valley extending about ten miles on each side of the river and about twenty miles up and down stream from Glasgow. The area covered is about 700 square miles, and three generating stations will be erected to meet the demand for power. The scheme has been promoted by a group of manufacturers who desire to obtain cheap electrical power and who realize that this can be better done by joining in a common system than by each putting down his own generating plant. The capacities of the respective stations will ultimately be about 10,000 K. W. each at Motherwell and Yoker, and 5,000 at Crookston. By utilizing cheap sites for the stations outside of towns and near to the coal mines, it will be possible to generate power at a very low cost. Of the 710 square miles covered by the scheme, only 13 are at present supplied with electricity. It is said that over 300 manufacturers petitioned in favor of the proposition, and it is thought that many of the remainder petitioned in favor of the rival Caledonian scheme which was turned down. The carrying out of this mammoth scheme of power distribution will place the manufacturers of Glasgow on a footing to be compared to that of American manufacturers who are so fortunate as to be within range of our cheap water powers. The authorized capital of the Clyde Valley Electrical Power Company is $4,500,000, with borrowing powers of $1,500,000. The total cost for plant on the transmission lines is estimated at over $2,000,000. The electrical apparatus, which will comprise polyphase alternating-current generators and transformers for high voltage power distribution, rotary converters for the supplying of direct current, etc., has been contracted for with the British Westinghouse Electric & Mfg. Co. Messrs. Strain & Robertson are the engineers of the Clyde Valley Electrical Power Company. Mr. Robert Robertson has recently spent a considerable period in the United States investigating our systems and methods of power transmission and distribution, particularly in our large cities and in such localities as Niagara, Snoqualmie Falls, Wash., Canyon Ferry, Mont., and other places.

—The New England Association of Teachers of Metal Work held its ninth semi-annual meeting at Boston, on Nov. 28 and

29. Besides the routine business the program included a number of interesting visits to some of the leading mechanical and engineering works around the "Hub."

—"The University of Illinois Press Bulletin" is issued fortnightly by the University of Illinois for the purpose of furnishing items of interest on University affairs. A recent issue contains an abstract of Professor E. B. Greene's address on "Impressions of the Southern People and Their Problems;" a review of the courses of study in business education; an account of the Quine medical library; abstracts of lectures on smoke prevention and on the bursting of flywheels; and various other items. On application this Bulletin will be sent to editors, to public libraries and to the high schools of the state, and all communications should be addressed to the editor, Professor Edward Fulton, University Hall, Urbana, Ill.

—The "paper work" or planning of the main picture of the Louisiana Purchase Exposition, is now practically completed. The main picture is the composition which fills the northern section of the Forest Park portion of the fair site. Here is a surface as level as is consistent with proper drainage, closed on the southern side by hills that rise to a height of about 65 feet. The component parts of this picture are the cascades and the cascade gardens, ten big exhibit buildings of various sizes and shapes, about two miles of basin, lagoon and canal, and about five miles of street and avenue. Of the ten exhibit buildings to be put up on this area most are under contract and have attained various stages of completion. The accompanying items tell the story of the buildings in the main exhibit group: Varied Industries Building, 525 by 1,200 feet, cost $645,000; Van Brunt & Howe, of Kansas City, architects; Roundtree Construction Company, contractor. Liberal Arts Building, 600 by 525 feet; cost $335,000; Eames & Young, of St. Louis, architects; John J. Dunhavant & Co., contractor. Electricity Building, 600 by 525 feet; cost $415,000; Walker & Kimball of Boston and Omaha, architects; Goldie Construction Co., contractor. Machinery Building, 525 by 800 feet, cost $510,000; Wildmann, Walsh & Boisselier, of St. Louis, architects; Smith & Eastman, contractors. Education and Social Economy Building, 525 by 750 feet; cost $480,000; Barnett, Haynes & Barnett, of St. Louis, architects; Kellermann Contracting Co., contractor. Art Building, 750 by 425 feet; cost $945,127.50; Cass Gilbert, of St. Paul and New York, architect; Goldie Construction Co., contractor. Mines and Metallurgy Building, 525 by 750 feet; cost, $502,000; Theo. C. Link, of St. Louis, architect; Hill-O'Meara Construction Co., contractor. Manufactures Building, 525 by 1,200 feet; cost $719,399; Carrere & Hastings, of New York, architects. Transportation Building, 525 by 1,300; Division of Works Designers, architects. Government Building, 850 by 200 feet; J. Knox Taylor, of Washington, D. C., architect; let in two contracts. Not only those buildings in the main picture, but also those which are located outside of the Forest Park portion of the site have advanced far. The latter are: Horticulture Building, 800 by 300 feet; Division of Works Designers, architects. Agriculture Building, 1,600 by 500 feet, Division of Works Designers, architects. In the avenues the landscape department has transplanted a great number of trees of large diameter, and shrubs and smaller trees in the nurseries are ready for the formal garden and bedding work which will come later. Plans for these gardens are practically completed. The most interesting development of the work is in the cascades and the cascade gardens. This composition, which is calculated to be the culmination of the decorative climax of the exposition, will be a concave hillside 1,600 feet across, covered with cascades, winding walks, gardens and sculpture. It will be situated at the junction of the avenues that radiate like the ribs of a fan.

—The Sprague Electric Company is receiving many orders for its direct current apparatus and reports among recent sales the following: Twenty 200-K. W. turbine generators, three 75-K. W. generators and four 20-K. W. generators to the De Laval Steam Turbine Co., Trenton, N. J.; one 200-K. W. belted-type and one 200-K. W. engine-type generator to H. O. Wilbur, Philadelphia; one 200-K. W. engine-type generator to the Otis Elevator Co., Yonkers; eight 8-K. W. generators, six 5-H. P. and four 1-H. P. motors to the Fisher Motor Vehicle Co., Hoboken, N. J.

NEW CATALOGUES AND TRADE PUBLICATIONS

These catalogues may be had free of charge on application to the firms issuing them. Please mention The Engineering Magazine when you write.

Air Compressors.

Catalogue, with illustrated descriptions of single-straight-line, duplex, half-duplex and compound air compressors, their parts and auxiliary apparatus. Also, illustrations of pneumatic tools and other machinery, and useful directions, information and tables. 9 by 6 in.; pp. 71. Chicago Pneumatic Tool Co., Chicago.

Belt Conveyors.

Pamphlet, with illustrations and descriptions of self-oiling dust-proof and other styles of carriers, return rollers, "take-up boxes," direct-pull take-up bearings, belting and other conveyor accessories. 9 by 6 in.; pp. 16. Stephens-Adamson Manufacturing Co., Aurora, Ill.

Big Horn Basin.

A pamphlet with map and illustrations, describing the Big Horn Basin in Wyoming and its farms, gardens, cattle ranches, irrigating canals, oil fields and other features which make it a desirable location for the farmer and stock raiser. 9 by 4 in.; pp. 36. Burlington Route, Passenger Department, St. Louis.

Boilers.

Cloth-bound catalogue, with illustrated descriptions of improved Galloway boilers, internally-fired return-tubular boilers and water-tube boilers, general specifications for boiler steel, views of plants which use Edge Moor boilers, and partial list of users. 9¼ by 6¼ in.; pp. 123. Edge Moor Iron Co., Edge Moor, Del.

Bolt and Nut Machinery.

Catalogue, with illustrated descriptions of bolt and nut machinery, including die heads, dies, bolt cutters, nut tappers, pointing machines, heading and forging machines, upsetting and forging machines, etc.; and useful tables and information. 6 by 9 in.; pp. 141. The Acme Machinery Co., Cleveland, Ohio.

Chemicals.

Circular No. 162, with current price list of many chemicals. 12 by 9 in.; pp. 4. The Roessler & Hasslacher Chemical Co., New York.

Coal Mining Machinery.

Catalogue, with illustrations and descriptions of electric coal-cutting machines, self-propelling trucks, pick machines, shearing machines, drills, locomotives, and electric generating and auxiliary apparatus. 7½ by 9½ in.; pp. 40. Morgan-Gardner Electric Co., Chicago.

Conveying Machinery.

Complete catalogue, No. 72, of elevating, conveying and and power-transmission machinery, chain belting and steel cable, with illustrations and descriptions of many styles of conveyors, their parts and auxiliary apparatus. 7¾ by 5½ in.; pp. 376. The Jeffrey Mfg. Co., Columbus, Ohio.

Dies and Taps.

Catalogue, with illustrated descriptions and price lists of stocks and dies, solid die plates, Reece's screw plates, Young's axle cutter, taps and dies for all purposes, and other tools for engineers' and steamfitters' use. 8¼ by 6 in.; pp. 64. Butterfield & Co., Derby Line, Vermont, and Rock Island, Quebec.

Electric Railways.

Book, entitled "Work Done," containing a record of some results accomplished in the field of high-speed interurban electric railway engineering in southern Michigan and other districts near the Great Lakes. The descriptions are well illustrated by half-tones from photographs and by reproductions of working drawings. 9 by 6 in.; pp. 100. Westinghouse, Church, Kerr & Co., New York.

Finishes.

Catalogue, with descriptions of Rice's 20th Century finishes for machinery, adamant cement machine paint, iron filler, machine enamel and other kinds of paint and varnish. 9¼ by 6 in.; pp. 24. United States Gutta Percha Paint Co., Providence, R. I.

Fuel Economizers.

Pamphlet, with illustrations and descriptions of the American fuel economizer for heating and purifying feed water for steam boilers by utilizing the heat in flue gases; and elevations and plans of typical plants, useful tables and data. 5¾ by 9¼ in.; pp. 56. Also, folder devoted to the American water-tube boiler, a combination of a plain double-deck cylinder boiler with an American fuel economizer. Brownell, Schmidt & Steacy Co., York, Pa.

Gas Engines.

Pamphlet, with half-tone illustrations and descriptions of the Walrath vertical gas engines, with one, two or three cylinders, in large and small sizes, and adapted for both stationary and portable work. 6¾ by 9 in.; pp. 27. Marinette Iron Works Manufacturing Co., Marinette, Wis

Grinding Machines.

Catalogue, with half-tone illustrations and descriptions of the Lea universal grinders, electrically-driven, in various styles. 9 by 6 in.; pp. 32. Also, catalogue devoted to Anderson air-cooled gasoline engines, and D. C. bulletin No. 100, devoted to the Anderson enclosed arc lamp. The Anderson Tool Co., Anderson, Ind.

Hardware.

Illustrative and descriptive catalogue of hardware, including farm and stable tools and fixtures, hinges and latches, door hangers, bicycle stands, carpenters' tools, plumbers' sinks, bone, vegetable and meat cutters, etc. 9 by 6 in.; pp. 120. E. C. Stearns & Co., Syracuse, N. Y.

Heating Apparatus.

Special circular No. 32, designed in black and red on enamel paper, illustrating and describing the Tynan patent annealer and the Tynan rivet-heating forge, both portable and operated by compressed air, and using crude oil as fuel. They are especially adapted to shipyard and railway-shop work. 12½ by 9½ in.; pp. 4. Chicago Pneumatic Tool Co., Chicago.

Hydraulic Jacks.

Catalogue, with descriptions, illustrations and prices of hydraulic jacks and punches, tube expanders, pipe vises, screw punches and pumps, and other boilermakers' specialties. 6¼ by 9¼ in.; pp. 18. A. L. Henderer's Sons, Wilmington, Del.

Mechanical Stokers.

Pamphlet, with descriptions and illustrations of the Duluth mechanical stoker, consisting of the Crowe revoluble grate and furnace, which prevents smoke, and of plants and ships where it is installed. 6 by 9 in.; pp. 24. Also illustrated booklet devoted to this stoker. Duluth Stoker Co., Duluth, Minn.

Pattern-Shop Supplies.

Catalogue, with illustrations, descriptions and prices of alcohol, glue, shellac, brushes, sand paper, dowels, metal letters, figures and stamps, fillets and fillet tools, vises, rapping plates, steel rules and tapes and other pattern-shop supplies. 9 by 6 in.; pp. 20 Timmins & Clissold, Bound Brook, N. J.

Pneumatic Apparatus.

Catalogue No. 2, with illustrated descriptions of pneumatic-motor chain hoists, pneumatic drills, reamers, center grinders, crane motors, portable winches, hoisting engines and other air tools. 9 by 6 in.; pp. 63. Empire Engine and Motor Co., Orangeburg, N. Y.

Pneumatic Tools.

Booklet, with illustrations and descriptions of pneumatic tools and other devices, including the Helwig patent pneumatic staybolt clipper, a reversible pneumatic motor, the Helwig bolt and rivet clipper, a self-feeding flue expander, etc. 3½ by 6¼ in.; pp. 16. Helwig Mfg. Co., St. Paul, Minn.

Pumping Engines.

Catalogue C, with illustrated descriptions of the Triumph pumping engines for general use, which pump water in a constant stream without pulsations. Also, guaranty and testimonials from users. 6¾ by 8 in.; pp. 43. S. W. Luitwieler Co., Los Angeles, California.

Pumping Machinery.

Catalogue, with illustrations, descriptions and price list of pumping machinery for many kinds of service, to be operated by steam, electric, gas, gasoline or other power. 9 by 6 in.; pp. 52. The Hill Machine Co., Anderson, Ind.

Pumps.

Circular No. 41, devoted to Roots' high-duty, positive-pressure, rotary pumps, which are without valves of any kind, and can be employed for all purposes where reciprocating pumps are used. 12 by 9 in.; pp. 4. P. H. & F. M. Roots Co., 109 Liberty St., New York.

Rail Bond.

Pamphlet, with illustrated description of the Thomas rail bond, which makes a flexible but substantial and enduring electric connection between the rails of electric roads. 9¼ by 6 in.; pp. 8. Edward G. Thomas, 4 State St., Boston, Mass.

Refrigerating Machinery.

Pamphlet, devoted to ice-making, refrigerating and other machinery, with half-tone and line-cut illustrations and descriptions of the York compression-type machine and its details, and views of refrigerating and ice-making plants. 7 by 10 in.; pp. 67. Also booklet with list of some recent sales. York Manufacturing Co., York, Pa.

Tenth catalogue of the Linde ice-making and refrigerating machines, ammonia fittings, ice factory and refrigerating machine supplies, with illustrated descriptions of apparatus and plants, and useful tables and data. 9 by 6 in.; pp.94. The Fred. W. Wolf Co., Chicago.

Rubber Goods.

Illustrated catalogue of plumbers', engineers' and machinists' rubber supplies, including packing, gaskets, valves, washers and diaphragms; brewers' and bottlers' supplies, rubber mats, sporting materials and other mechanical rubber goods. 8½ by 6 in.; pp. 143. Morgan & Wright, Chicago.

Shipbuilding Specialties.

Sections of shipbuilding material and patterns of chequer plates, including bulbs, angles, deck beams, moulding, hatch bars, bulwark rails, jackstay bars, engine foundations, etc., with illustrations and code words. 11 by 9 in.; pp. 15. H. Ronnebeck, Middlesbrough-on-Tees.

Steam Engines.

Catalogue, with illustrated description and dimensions of heavy-duty Brown-Corliss steam engines and their parts. 7 by 12 in.; pp. 11. Brown-Corliss Engine Co., Milwaukee, Wis.

Catalogue, with illustrations and descriptions of high-grade vertical, automatic steam engines of from 2 to 37 horse power, and their parts, safety water-tube boiler, engine and boiler outfits, and accessory apparatus. 9 by 7 in.; pp. 36. Also, bulletin No. 100, devoted to direct-connected generating sets. Racine Hardware Co., Racine, Wis.

Pamphlet, with half-tone illustrations and descriptions of Watertown steam engines, their parts and accessories. 7 by 9 in.; pp. 36. Watertown Engine Co., Watertown, N. Y.

Steam Separators.

Catalogue No. 12, with descriptions, illustrations, dimensions and prices of Austin separators for both live and exhaust steam, and the Austin patent spraying device, for separating lubricating oil from steam. 6 by 9 in.; pp. 20. Austin Separator Co., Detroit, Mich.

Steel.

Pamphlet on "Jessop's steel and how they make it," with well-illustrated description and a plan of the Brightside works and of the manufacturing processes carried on there. Also, a view of the new works at Washington, Pa. 6 by 9 in.; pp. 74. William Jessop and Sons, Ltd. Sheffield, Eng.

Welsbach Light.

Large catalogue, with illustrations and descriptions of gas mantles, shades, globes, burners, reflectors, chimneys, portable stands, gas arc lamps, fixtures, fittings, combination cylinders, supplied with asbestos rings, and sundries. 12¼ by 9½ in.; pp. 38. Welsbach Company, Gloucester City, N. J.

IMPROVED MACHINERY

New Processes and New Appliances

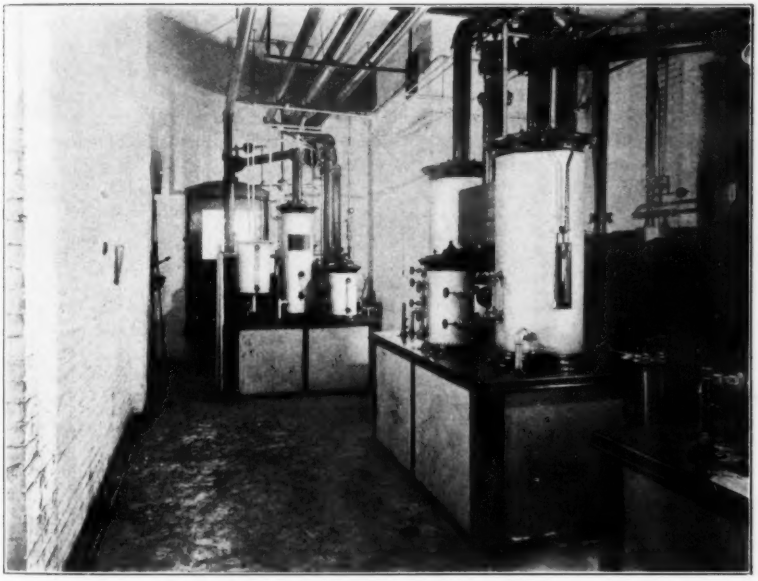
The matter here published is not paid for, nor can it be classed as advertising. But as the information is necessarily obtained from those who offer the appliances for sale, it is proper to say that the manufacturers, rather than ourselves, are responsible for the statements made.

Mechanical Heating Processes in the U. S. Mint.

THE new U. S. Mint at Philadelphia has deservedly attracted attention, not only here but in Europe, on account of the departures made from former practice in providing its equipment.

This mint has now been in practical operation over one year, and sufficient time has therefore elapsed to warrant the statement that its equipment is thoroughly efficient, up-to-date, and generally a pronounced success. It reflects credit alike upon the judgment of the mint officials who selected the machinery, and upon the makers and designers of the various parts of the equipment.

The most radical departure from methods followed in the old mint was made in the installation of modern heating tools, all of which were especially designed to perform heating processes peculiar in many respects to the manufacture of coin, but which are adaptable to metal work generally, where correct and uniform heating is indispensable for the production of the best quality of work.



AMERICAN OIL-GAS MACHINES IN THE U. S. MINT.

After thorough inquiry into all other methods which seemed applicable to this special work, the mint officials adopted the fuel-gas system of the American Gas Furnace Co. A series of experiments had been made in the old mint, notably with anneal-

ing machines, which demonstrated their superiority over old methods, and which led to the adoption of the present system after a thorough demonstration of its advantages.

The contract was made for a complete outfit, embracing gas-making plant, furnaces and heating machines, and the makers were placed under heavy bonds to secure the performance of stated requirements, which have been met so satisfactorily that the mint bureau has ordered the adoption of the same system in other mints, notably those at New Orleans and San Francisco.

The advantages derived from the use of gas as fuel in the principal departments may be briefly stated as follows:

In melting: Speed and uniformity of operation, and the absence of ashes heretofore refined at heavy expense.

In annealing: Little or no oxidation, perfect uniformity of the anneal, and speed and convenience in operation.

In assaying: Uniformity and perfect control of heat, reliable cupelling, quick melting, and uniform conditions in testing metals.

In the engraving department: The perfect annealing of die blanks, correct heating for hardening dies; and generally a speed and uniformity in all heating processes which are now performed with a degree of precision, convenience and cleanliness heretofore unknown in work of this kind, and this at a fuel cost not exceeding the fuel bills of the old mint for the same output of finished coin.

The saving in the melting department resulting from the absence of ashes to be refined at heavy expense for acids, and for grinding and handling the same is especially notable. In the annealing department the uniformity and thorough anneal makes it possible to roll the stock to the exact size and effects a large reduction in the percentage of rejected coin, and a considerable saving is also made in the amount of acids required for removing oxidation from the surface of the strips and blanks.

A room situated in the basement contains three American oil-gas machines shown in the illustration, which draw their oil supply from four tanks buried 4 feet under the yard level just outside of the eastern wall of the building. Connections between the gas machines and storage tanks are so arranged that the machines can be fed from either one of the four tanks. Each tank has a capacity of 8,000 gallons, so that their aggregate capacity is over 30,000 gallons, which, converted into naphtha gas, represents the equivalent in heating power of about 6,000,000 cubic feet of ordinary illuminating gas.

The three gas machines are operated independently, so that various departments, whose requirements differ may receive their gas under conditions of quality and pressure best suited to their special work, but they are so connected that either machine can be used in place of another, and so that the three machines can work together if desired.

The process of making naphtha gas is perfectly automatic, and requires the attention of but one man for a short time each day, mainly to see that all the working parts are lubricated, that a small battery, which operates the electric thermostats, is in order, and the gas room and machines are kept in tidy condition.

In considering this plant as a whole, two or three things are likely to attract the attention, namely, first: The wide distribution of a gas which is not a "fixed gas" without deterioration, which can be fully appreciated only by looking at the building and remembering that the gas is conducted to every part of it, and which justifies the claim made by the inventors of this process that it produces a "practically fixed gas." This is especially shown in the laboratory of the assay office, where very fine and delicate burners must receive a constant and perfectly uniform gas to do satisfactory work, which has been accomplished to the entire satisfaction of the chief assayer and his assistants.

The second point worthy of note is that throughout the whole building there is not the faintest trace of coal-soot or ashes, that the departments which in the old mint were almost inaccessible owing to dust, dirt, and ashes, are here as clean and tidy as a well-kept machine shop.

The third point which will occur to the close observer is that while heating processes are usually conducted with uncertainty, they are here performed with the precision and uniformity which is the strik-

ing characteristic of modern machine tools. The plant was installed by the American Gas Furnace Co. as planned by its president, Mr. E. P. Reichhelm, in co-operation with Mr. Edwin S. Church, superintendent of machinery of the mint, and the introduction of the new methods in the mint service is largely due to the late superintendent of the mint, the Hon. H. K. Boyer, who took the responsibility of recommending their adoption.

Further details concerning this very interesting heating system will be gladly furnished, on request, by the American Gas Furnace Co., 23 John St., New York.

New Idea Calculator.

THE New Idea Calculator is a machine especially constructed for figuring pay rolls. It is cylindrical in form, about nineteen inches long by six inches in diameter, so that it takes up but little desk room.

The machine is built with two movable concentric barrels. The inner barrel carries figures showing the number of hours and the wage amounts corresponding to different rates. The outer movable barrel consists of a perforated shutter, which is set so that the opening comes opposite the wage rate used, thus allowing only one amount to be visible at a time, and preventing all possibilty of mistake due to a multiplicity of figures, such as are found in a table.

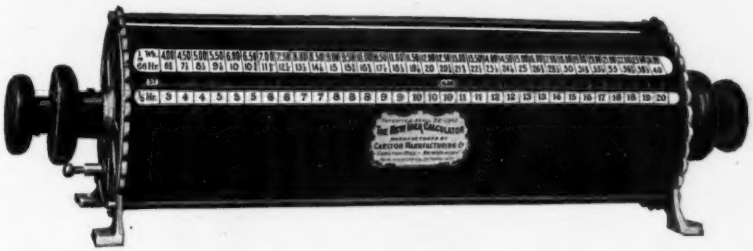
Outside these movable barrels is a cylindrical case with a longitudinal slot, through which the figures on the inner barrel are visible. Above this slot are two rows of figures, showing respectively, the rates of wages per week and per hour. Beneath it are figures giving the amounts of wages for one-half hour at the different rates. Figures for quarter hours and three-quarter hours can be added if desired, and the machine can be made for both time and piecework systems.

The inner barrel is pleated, so that the figures thereon are thoroughly protected from dust and wear, and the whole construction of the machine is simple and durable.

There are knobs at both ends for turning the barrels, so that the calculator can be operated with either hand.

It requires no experience to use this machine, and its working can be understood at a glance. It effects a great saving of time and trouble, it eliminates the chance of error and it is guaranteed to be absolutely correct.

It is suitable for use by manufacturers, contractors, railroads, etc., and any further particulars will be gladly furnished by its makers, the Carlton Manufacturing Co., of 76 Franklin Street, New York.



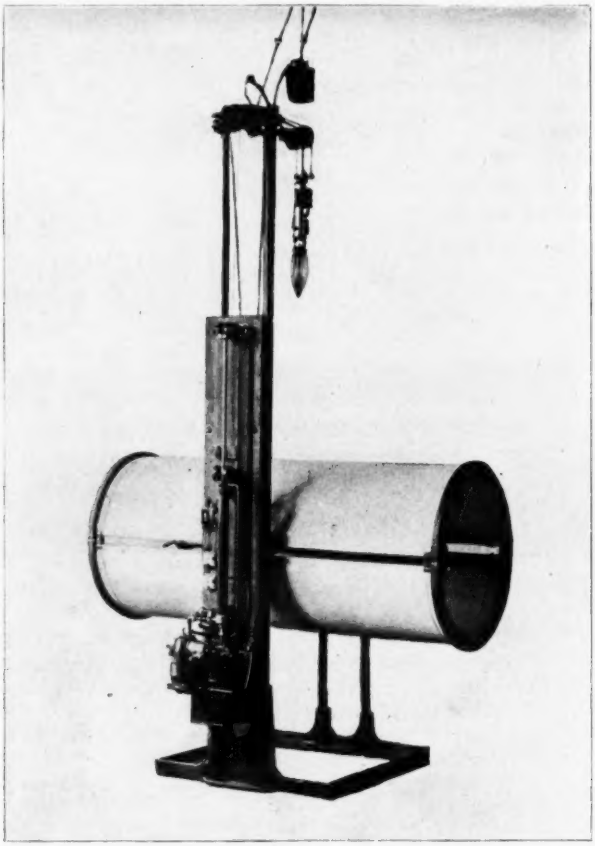
NEW IDEA CALCULATOR.

Electric Blue-Print Machine.

THE importance as well as the general utility of the application of electricity to blue printing appeals to every architect, engineer and draftsman, to whom the production of blue prints with the best of solar facilities has doubtless often been vexatious. On dark and cloudy days of winter, as well as on rainy days in summer, and at all times during the year when the light is poor, smoky or irregular, the advantage of having an electric equipment is appreciated by the possessor. The illustration on the next page shows the latest and most advanced type of machines for printing by artificial light.

The apparatus consists of a cylindrical printing frame, composed of two heavy curved plates of glass, bedded in soft material in an adjustable, though rigid frame, together with two tubular uprights which support the arc lamp and automatic drive mechanism. This drive operates the lamp,

In operating, the cylinder is revolved to a horizontal position, and the tracings and sensitized paper are placed around the outside of the cylinder, being confined by stout canvas covers, which are drawn tight by turning a lever, thus insuring perfect contact between tracings, sensitized paper and



EUGENE DIETZGEN BLUE-PRINTING MACHINE.

having means for lowering it through the cylinder and then automatically raising it again to its former position.

The cylindrical frame revolves on trunnions, so that it can be swung to a horizontal position, which is the most convenient method for inserting or removing tracings and paper from the frame.

the glass. The cylinder is then swung to the opposite horizontal position and the same manipulation repeated, after which it is returned and locked in a vertical position and is ready for printing.

By simply touching a lever the arc lamp starts in its descent through the center of the cylinder at a speed which can be regu-

lated to suit the sensitiveness of paper employed. When the lamp has reached the lowest point of the printing surface, it automatically reverses its motion and quickly returns to its original position above the cylinder.

The limit of the motion of the lamp can be set according to the size of the prints to be made.

The cost of making blue prints by electric light, where the full capacity of the machine is utilized, is practically cheaper than by the use of sunlight, and with an average allowance made for wasted material under the ordinary method due to over-printing, etc., with attendant loss of time, the cost is found to be below that of the sunlight process.

The Eugene Dietzgen Co., of Chicago and New York, manufacturers and importers of drawing materials and surveying instruments, will be glad to furnish any more information desired concerning this machine.

SIX-WHEELED COMPOUND SWITCH ENGINE.

Six-Wheeled Compound Switch Engine.

THE six-wheeled switch engine illustrated herewith was built at the Rhode Island Works of the American Locomotive Company, and represents a lot of this type recently placed in service on the New York, New Haven and Hartford R. R. These engines are practically duplicates of a lot placed in service in 1900, though a trifle heavier, and are notable in particular for the cylinder arrangement, since it is unusual to apply the compound system to engines of this class. The engines are of the two-cylinder compound type, of the system perfected by the American Locomotive Company, with cylinders 20½ by 31 by 26 inches, and are capable of exerting a tractive force of 30,600 pounds. The total weight of 135,800 pounds, which is also the adhesive weight on these engines, insures the development of the maximum power at the rail, as the ratio of adhesive weight to the latter is 4.43. The question of weight to hold the engine to the rail under maximum piston effort is of supreme importance in yard work where the rails are usually in a condition to render an engine of little use, when without a proper amount of load on drivers.

A boiler pressure of 215 pounds per square inch denotes a close approach to limiting practice in this direction, and the weight of 219,000 pounds for engine and tender indicates a machine for very heavy work. The boiler is of the straight type, with 1,560 square feet of heating surface, 144 of which are in the fire-box, and the grate has an area of 28 square feet. These values give ratios that are seen to be in harmony with the recommendations of the Master Mechanics Association for bituminous coal.

Steel castings enter largely into the construction of these engines, such as wheels, driving boxes, etc., in accordance with the best modern practice, and taken as a whole they furnish a fine example of a heavy switch engine designed for the most exacting work of that service. The compound principle having been demonstrated to be a factor of economy in road operations, there is no valid reason to predict any other record for it in yard service, and the fact that these engines are a duplicate order would logically lead to such a conclusion.

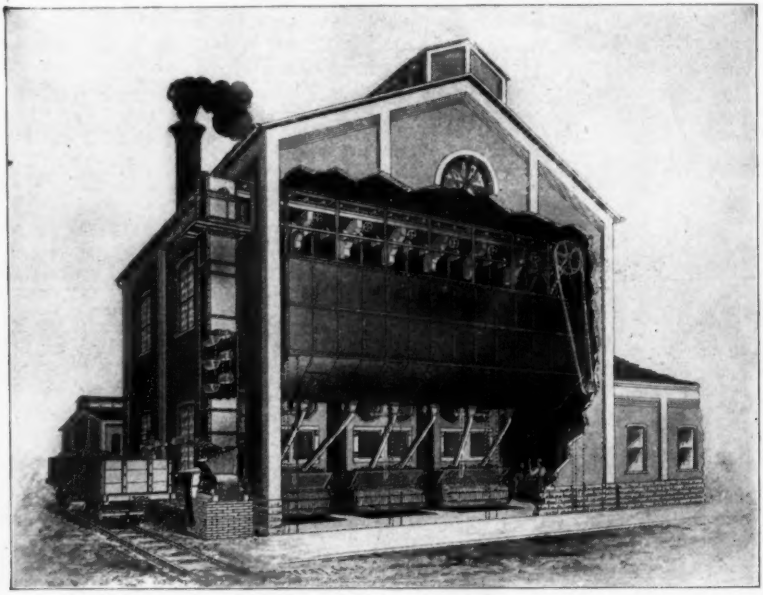
Further information concerning these locomotives will be gladly furnished, on request, by the American Locomotive Company, 25 Broad St., New York.

Jeffrey Power Plant.

THE Jeffrey Manufacturing Company's power plant is a modern steel and brick fireproof building, provided with good light and ventilation. The boiler room is equipped with three 250-H. P. Babcock and Wilcox boilers, fitted up with chain-grate stokers. The induced draft system is used in connection with the boilers and is put in in duplicate, thus making provision for any accident that might occur. Modern purifiers and feed-water heaters are also features of the plant.

Another feature of the boiler room is the absence of the customary coal pile in front of the boilers. This is due to the storage tank built and erected by this company. This tank is of 280-tons capacity, and the coal is unloaded directly from the cars into an elevator boat, or in case of lump or run of mine coal, into a crusher which is directly over the boat. The coal is taken to the tank by the continuous Jeffrey bucket system, made and installed by this company. The tank is in direct communication with the stoker by means of chutes, provided with a gate valve, operated by a hand chain and wheel from the floor. The engine room is equipped with three 250-H. P. high-speed engines, belt connected to the three 150-K. W., 250-volt Jeffrey generators. The switchboard is of black polished slate, especially designed and built by the Jeffrey Co.'s electrical department to suit their requirements. The power is furnished from this board to the different departments, which are electrically driven, the light and power lines being independent for each one.

An air compressor is also installed in the engine room, which furnishes power for a number of pneumatic hoists and tools throughout the works. While this power plant is not very large, it is arranged to operate in the most economical manner possible.



JEFFREY POWER PLANT.

Any one interested in this class of machinery will do well to write The Jeffrey Manufacturing Company, Columbus, Ohio, manufacturers of machinery for industrial and power plants, coal mining machinery, screening machinery, elevating and conveying and power transmission machinery, and electric locomotives.

Gasoline Pumping Engines.

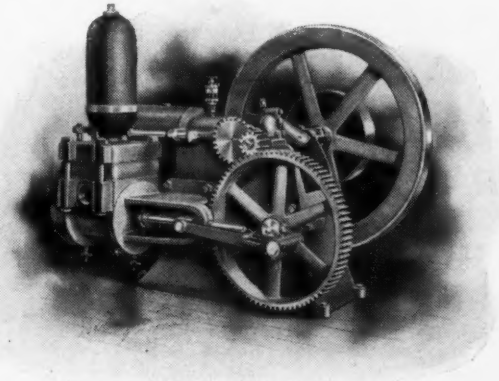
THE National Junior gasoline engine is built to do work. It is constructed with the greatest care, contains probably fewer pieces than any other machine of its class on the market, and is so designed as to make each part very easily accessible.

The cylinders are bored on a special machine made for this particular class of work, and are finished to a mirror-like surface exactly to size. The pistons are properly ground on special machines. The connecting rods and crank shafts are drop forged from solid bars of steel. The metal used in the bearings is of the highest grade, genuine babbitt or bronze. The gears are cut with special machinery built to order by the leading gear manufacturer of the country.

The gasoline is carried in the cast iron base of the engine where there is no possible danger from explosion. It is not conducted to the engine by gravity feed, but is elevated from the base only as it is used. The advantage of not using an elevated gasoline can is easily understood. Gravity feeds are dangerous, for should the engine stop when the attendant is not near, the gasoline will continue to flow, filling the engine with gasoline, after which the floor will probably become saturated. Gasoline cans are liable to become leaky, and small pipe connections are liable to become broken. These difficulties are entirely obviated in the National Junior engines.

A rigid course of inspection of workmanship and material enables a perfect working engine to be produced, with all parts absolutely interchangeable. After being assembled, these engines are given a test of two or three days continuous running under full load; each engine is numbered and has its record kept on file, so that in years to come any part which may be broken can be supplied without trouble.

The engine shown in the illustration is designed to fill the want for a well made and reliable pumping outfit. It will pump thirty barrels of water per hour to a height of one hundred feet. The pump is very strongly constructed and rigidly attached to the engine. The pump piston rod is made of the best Tobin bronze especially drawn for this class of work. The piston and removable pump lining are of the hardest bronze. The stuffing-box and gland are also of bronze, making all working parts of the pump rust proof. The combined pump and engine is valuable for fire protection to mills, barns or residences. It serves as a very efficient water-works for suburban residences, summer hotels and resorts. The engine is furnished with a belt wheel so that it can be used independently for power purposes. It takes but a few seconds to disconnect the pump. The engine is shipped ready to run. and is supplied with wrenches, oil can, batteries, spark coils, switch, and wire to connect batteries.



NATIONAL JUNIOR GASOLINE ENGINE.

In another engine, designed for deep-well

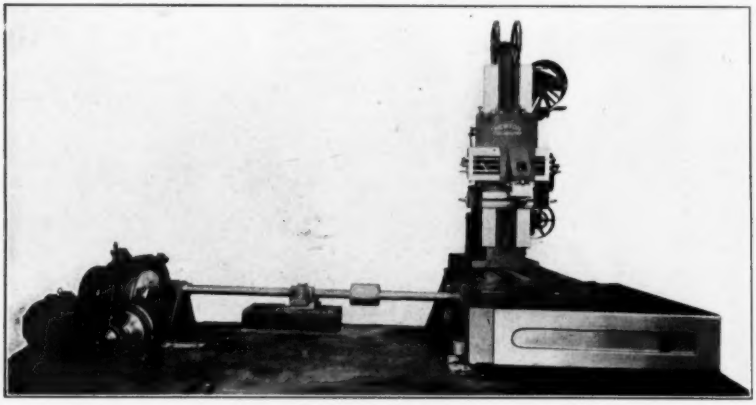
pumping, the pump beam furnished with it is so arranged as to give a slow upward working stroke and a rapid downward return stroke of the pump, which arrangement makes it possible to lift more water than when the upward and downward strokes are made at the same speed, and at the same time less wear is produced upon the pump.

The National Junior engines are the product of fifteen years of practical gas engine experience. The designers have been associated with some of the leading builders of heavy engines for many years, which accounts for every detail of the National Junior having been developed to such a high state of perfection.

Any further information concerning these gasoline engines will be gladly furnished by the manufacturers, the Wolcott Windmill Co., Saginaw, Mich.

Spur-Gear Planer.

THE R. D. Nuttall Co., of Pittsburg, have been recently furnished by the Newton Machine Tool Works of Philadelphia, with a gear-cutting machine of unusual capacity and embodying many new and interesting features. While the operation of the machine is similar to that employed in some of the bevel-gear shapers, this is an original application of the principle to the formation of spur gears, inasmuch as the gears are placed on the machine in a horizontal position, instead of a vertical one, as in other machines. A good general idea of the machine is gained from the illustration which was taken before the machine left the shop. When in place the top of the dividing table is nearly flush with the shop floor and most of the indexing mechanism is below the floor line. The gear, lying flat upon the dividing table, is accurately spaced around by the dividing mechanism shown at the left of the picture, and the teeth are shaped to templets by a tool carried in the vertical slotter. This slotter has a stroke of five feet and is driven by a spiral gear connected to the bevel gearing shown on the countershaft.



SPUR-GEAR PLANER

The countershaft itself is driven by a motor enclosed within the column. The vertical column can be moved in and out to any desired position on the extension bed and will accommodate gears up to 30 feet in diameter. If a greater capacity was required, the bed could be extended indefinitely to take any size of gear.

When completed, this machine was tested by means of a transit placed on the dividing head and sighted on a point about 40 feet distant so as to multiply the error, which, however, proved to be almost imperceptible.

Any further information regarding this interesting machine will be gladly furnished by the R. D. Nuttall Co., who use it with great success in their manufacturing work.